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INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 1

JANUARY 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

CENTRAL FOOD TECHNOLOGICAL RESEARCH INSTITUTE, * MYSORE. *
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PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE INDIAN PRESS, LTD., ALLAHABAD

ICAR—21-1-48
2,800

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INDIAN FARMING

JANUARY, 1948

Vol. IX No. 1

JUTE IN THE INDIAN DOMINION*

Since we met in January last there have been important changes in the constitutional position of the country. India has been divided into two separate Dominions. In pursuance of the stand-still orders on the eve of the partition of India, our half-yearly meetings which were scheduled to be held in July last had to be cancelled. We are, therefore, meeting today for the first time in independent India. I would like to point out that with the independence of the country, our responsibilities have increased as 80 per cent of the jute production has gone to Pakistan and we have to make every effort to make ourselves self-sufficient in this respect.

Before we proceed to discuss the important problems which have been included in the agenda of today's meeting, let me welcome in our midst the two new members, viz. Mr. K. K. Chetteur, Additional Secretary to the Government of India, Ministry of Commerce, who has been added to the Committee as an extra nominee of the Government of India, and Mr. G. R. Jaffer who has been nominated by the Muslim Chamber of Commerce in place of Mr. M. A. H. Ispahani, resigned. The Committee's thanks are due to the outgoing member, Mr. Ispahani, for very valuable service rendered by him to the Committee.

In the new constitutional set-up of the country, the important problems which the Committee will have to face and which it has been called upon to discuss and consider are: What is its position after the partition? What changes and modifications, if any, are necessary in the constitution of the Committee and in its Rules and Regulations? What should be its future programme of work and finances required to implement that programme? The position has been fully explained in the papers that have been circulated to you. The legal position is that the Committee is a semi-autonomous Society registered under the Societies Registration Act and, as such, has full powers to change its Rules and Regulations as long as they do not affect the objects of the Society. The registered Head Office of the Committee being situated in Calcutta, i.e. within the Dominion of India, the controlling authority is the Government of the Indian Dominion. The Committee is also financed solely by funds received from the Central Government. Under the law, funds provided by the Government of India cannot be spent outside the Indian Dominion. It follows therefrom that the activities of the Committee outside the Dominion of India should be terminated.

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* Address delivered by Sir Datar Singh, President of the Indian Central Jute Committee, in opening the meeting of the Governing Body of the Committee on 10 December, 1947.

Another important question before the Committee is to find out ways and means for increasing the production of jute in the Indian Union in order that the requirements of the jute mills situated within the Indian Union may be met. The problem is well-known to the members and has already been tackled by the Local Sub-Committee of this Committee. It is necessary now to formulate a definite proposal in this respect and make our recommendations to the Government of India and the Provincial Governments for implementing such recommendations.

I am glad to inform members that, as a result of my personal discussion yesterday with the Hon'ble Minister for Agriculture, Forests and Fisheries, it has been decided that:

(a) West Bengal Government should start a scheme for Government procurement of any surplus jute seed that may be with the cultivators for utilization in extending cultivation of jute in the coming season.

(b) The Hon'ble Minister has agreed to give us 50 acres of land at the Chinsurah Agricultural Farm and any other accommodation that may be available there for housing the staff and laboratory equipment of the Dacca Jute Agricultural Research Laboratory.

(c) They have agreed to explore the possibility of growing every variety of jute on *aman* lands for which the Indian Central Jute Committee will give all the necessary technical advice and help, so that as much of such land as is possible may be brought under jute cultivation in the coming season.

(d) Survey of the land now lying fallow has already been made, and the Hon'ble Minister has agreed that with the cooperation of our expert staff and their own agricultural staff, all such land which can be brought under jute cultivation should be taken up immediately.

(e) They have also agreed to get us temporary accommodation in the Hooghly Mohsin College till the Chinsurah Agricultural Farm is shifted to Haringhata, when these buildings and more land will be made available to the Committee. The Hooghly Mohsin College authorities have been approached in the matter.

You will agree with me that to increase the immediate production of jute, beside other methods, it is of utmost importance that we should procure seed, utilize *aman* land for sowing the early varieties of jute, and bring uncultivated land under cultivation where jute can be grown. For this purpose, as I have already told you, the West Bengal Government has agreed to take the necessary action. Similarly, I will take up these matters with the Governments of Bihar, Assam and Orissa.

The area under *aman* paddy in West Bengal, Bihar, Assam and Orissa is approximately 10 lac acres. I realize that it will not be possible to bring all this area under jute on account of lack of irrigation facilities and fertility of the soil, but certainly there will be a considerable area, which can be immediately put under jute by supplying seeds and manures at concessional rates. For this purpose the Provincial Governments may require the help of the Committee, which it should be prepared to give. Thus, we will be able to increase our jute production by 20 lac bales if all this is done immediately and the cultivators are able to sow jute in March next. Our agricultural staff should immediately get in touch with the staffs of the Provincial Governments to give them all the help and guidance in the light of researches which have been carried out during all these years, so that the cultivators may be persuaded to take up jute cultivation. One stumbling block in our way will be the scarcity of seed, to overcome which, as I have already said, the West Bengal Government have agreed to procure seed and I hope similar steps will be taken by the other Provincial Governments. I would like to stress that the provinces should try to grow more improved seeds on their own farms and also encourage registered seed growers to do the same so that ample supplies of improved seeds may be available for covering the *aman* lands as well as uncultivated lands which can be brought under jute cultivation.

Before I sit down, I would like to draw the attention of the members to the further developments in the Jute Museum which have taken place since it was started in January last. Members may be interested to look into the Museum after the conclusion of the Committee's meetings.

I do not like to detain you any longer as we have got a heavy agenda before us, but, before I ask you to proceed with the business I would like to thank you for the trouble you have taken in coming here, particularly in these days when travelling and accommodation problems are so difficult.

Original Articles

THE SUGARCANE CROP IN THE VIZAGAPATAM DISTRICT AND ITS WEATHER REQUIREMENTS

By A. SANKARAM

THE success of crop production is largely measured in terms of yield per unit area, as it is the largest single factor determining the economics of crop production and is probably the simplest basis for judgment of agricultural efficiency. The possibility of achieving maximum crop yields is everywhere conditioned by a large number of factors and differences in yield from field to field and from year to year are traceable to the interplay of many factors which exercise their influence in a variety of ways. In an editorial note in the *Indian Farming* (July, 1945) it was stated that statistical analyses of records of experimental farms indicated that 50 per cent of the variability in crop yields was due to climatic and weather factors alone. A study of crop yields in relation to climatic factors is, therefore, of immediate importance for all crops and should be accorded priority in respect of an industrially important crop like sugarcane. As a preliminary to this end, a precise knowledge of the cultural operations along with their normal weather requirements specific to the crop and the locality becomes essential. Such an information relating to sugarcane crop, as cultivated in the Vizagapatam District, where its economic importance and preference among cash crops is gaining ground day by day, is embodied in the present paper.

In this attempt, recorded data relating to crop growth and climatic factors at the Agricultural Research Station, Anakapalli, over a decade, available to the author, was made use of. The representative character of such da a, to be of applicability to the District, is not doubted since soil and climatic conditions obtaining at the Agricultural Research Station, Anakapalli, fairly represent most of the cane-growing areas of the District.

A. SANKARAM is Superintendent, Agricultural Research Station, Anakapalli.

Trends of climatic factors at Anakapalli

With the grant of a subsidy from the Indian Council of Agricultural Research, the Agricultural Research Station, Anakapalli, has become the hub of research activities on sugarcane. The cultivation of the cane crop on an extensive scale and its intensive study became the work of first importance. The study of the crop included a record of climatic and weather conditions, viz. rainfall, maximum and minimum temperatures and humidity. Monthly averages of the relevant data for the ten-year period under review (1936—45) is given in a concise form in Table I.

TABLE I

Summary of climatic factors at Agricultural Research Station, Anakapalli (1936-45)

Months	Rainfall in inches	Rainy days*	Maximum temperature	Minimum temperature	Humidity (per cent) 8 A. M.	Wind velocity M. P. H.**
January	0·28	0·80	85·13	63·25	83	2·10
February	1·27	2·10	87·35	65·84	82	2·35
March	1·24	1·70	92·61	70·67	84	3·50
April*	1·43	1·80	95·38	75·95	83	4·99
May	3·09	3·90	98·04	80·24	76	5·05
June	4·02	6·60	95·12	79·83	75	4·44
July	4·32	8·90	90·91	77·71	87	5·12
August	4·76	8·40	91·84	77·38	89	3·97
September	7·28	11·10	90·79	77·03	89	2·11
October	9·27	9·00	88·56	74·11	89	1·56
November	2·81	3·60	85·60	68·08	84	1·55
December	0·32	0·40	83·70	63·88	79	1·83

The climatology of Anakapalli, as revealed by the data presented above, shows that it is one of a tropical nature admirably suited for cane culture. A detailed examination of the monthly data in respect of the climatic factors mentioned above during the different years of the period under review (not included in the paper) warrant the following conclusions:

(i) The trend of variations in rainfall in the different months for the ten-year period is neither accidental nor unusual to the period but are fairly general and representative in character.

(ii) The distribution of rainfall in particular lacks uniformity.

(iii) The temperatures, both maximum and minimum, and humidity varied within negligible limits.

(iv) Temperatures, maximum or minimum, fatal to crop growth were not recorded during the period of ten years.

Normal weather requirements of the crop

Although not distinguishable from one another by clear-cut lines, as they in fact overlap, the sugarcane crop has three phases in its life-cycle, viz. germination and tillering, grand period of vegetative growth and ripening or maturity. The seasonal or weather requirements for these three phases of crop growth are described below in detail.

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* Less than ten cents of rain is not counted as a rainy day.

** Average of five years only.

First growth phase: Germination and tillering constitute the first growth phase in the life-cycle of the cane crop, which runs for a period of nearly three months from March to May, with reference to the normal planting season of March. The climatic factors prevailing during the period and the inherent capacity of the variety are the two factors that govern the success of the process. It may be mentioned that the practice is to irrigate the crop and hoe the field after planting whenever necessary. The seasonal and weather effects represented by the data given in Table II play their role in respect of germination mainly supplementing the irrigational effect. It is seen from the tabulated data that an evenly distributed rainfall during the period supplemented by timely irrigation enables the soil to maintain an optimum moisture content for successful start and rapidity of germination. It is a general experience that rapidity of germination is considerably favoured by bright days with low humidity. The rapidity of germination appears to be important as it would enable the buds to escape any attack by white ants, common in lighter types of soils. Temperatures, maximum or minimum, fatal to the process have never been experienced. It is a common experience that with an unevenly distributed rainfall resulting in periods of drought extending over three weeks, and in places of deficient water supply, the crop falls an easy prey to shoot-borer attack. Active tillering seems to commence by the middle of April and extend till the end of May. Tillers arising later are removed by growers and this operation is done on a very rational basis in that such late formed tillers rarely survive and seldom reach maturity along with others.

TABLE II

Seasonal conditions during the first growth phase

(Average of three years)

Standard week	10	11	12	13	14	15	16	17	18	19	20	21
Calendar days	5-11	12-18	19-25	26-1	2-8	9-15	16-22	23-29	30-6	7-13	14-20	21-27
Months	March				April				May			
Rainfall inches	0·04	...	2·65	...	4·32	1·06	0·26	0·09	...	0·06	...	0·65
Number of rainy days	...	...	2	...	3	1	...	...	...	...	...	1
Average maximum temperature	1·7	93·9	91·0	91·4	91·9	89·9	89·9	93·4	97·4	97·7	98·5	96·7
Average minimum temperature	69·8	70·0	72·5	71·0	72·7	69·7	76·5	76·6	78·1	77·2	81·5	79·8
Average humidity per cent	83	82	81	82	84	82	82	83	8	84	85	83
Germination per cent	...	...	25·0	50·6	57·8	60·7	61·5	62·0				
Tillering (monthwise)	0·98				2·60				2·90			

Absolute maximum temperature during the period 105·1

Absolute minimum temperature during the period 64·2

Grand period of vegetative growth

Early in June, with the cessation of tillering, the crop enters its second growth phase, viz. the grand period of vegetative growth, which lasts till the end of November. Seasonal conditions prevailing during the period and progressive crop growth, as represented by monthly height measurements of the crop, are given in Table III.

TABLE III

Seasonal conditions during the grand period of vegetative growth
(*Average of three years*)

Climatic factors	June	July	August	September	October	November
Rainfall (inches)	3·70	6·02	4·30	7·41	10·63	1·20
Number of rainy days	5·30	12·60	8·60	11·00	8·00	2·30
Maximum temperature °F	97·50	89·90	91·50	89·90	88·20	85·70
Absolute maximum temperature °F.	107·70	96·10	97·00	94·10	93·70	89·60
Minimum temperature °F	80·50	77·60	77·30	76·80	74·60	67·90
Absolute minimum temperature °F.	73·70	74·50	73·40	73·20	68·90	60·20
Humidity (per cent) 8 A. M.	76	87	88	89	89	82
Wind velocity M.P.H.	5·33	6·17	4·14	2·49	1·32	1·37
Growth of crop (inches) Co. 419	34	56	68	90	109	121
Sap concentration—corrected Brix.	...	...	...	9·21	11·25	13·10

From a study of the data (Table III) it is seen that seasonal and weather conditions prevailing during this phase of crop growth are most favourable, as there obtains a plentiful water supply, high humidity, greater warmth, the prime requisites for vegetative growth. All available plant enregy is directed towards vegetative development as evidenced by an elongation of the stem and low concentrated plant sap. Lack of moisture during this active vegetative growth period is apt to have more serious effects than at any other stage in the life-cycle of the crop. The peak of vegetative development is reached towards October and the crop attains a weighty stand on the field. It is at this stage that it is occasionally subject to cyclonic winds and farmers know to their cost the devastating effects of such winds. Cyclonic winds are not uncommon and crop safety cannot be assured when the wind velocity exceeds 15 M.P.H.

Ripening or maturity

With the beginning of December starts the cold season. With this sharp change in weather the crop enters the third phase of its life-cycle. The cane begins to ripen which is evident by increased sucrose content in the juice. This is conditioned largely by climatic factors during the period.

The progressive enrichment of the plant sap leading to maturity of the crop as reflected by monthly analytical data of the plant sap (juice) and the seasonal conditions leading to final crop maturity are presented in Table IV.

TABLE IV

Seasonal conditions during ripening or maturity

(*Average of three years*)

Climatic factors	December	January	February	March	April
Rainfall in inches	0·07	0·43	0·53	0·90	2·58
Number of rainy days	0·30	1·00	1·30	1·60	3·30
Maximum temperature °F	83·80	84·70	87·20	92·30	93·70
Absolute maximum temperature °F	86·80	88·50	93·50	97·40	99·10
Minimum temperature °F	62·20	63·10	65·20	69·70	75·10
Absolute minimum temperature °F	56·80	55·20	60·50	64·10	69·40
Humidity (per cent) 8 A.M.	79	83	81	84	82
Wind velocity M.P.H.	1·83	2·10	2·35	3·50	4·99
Juice quality Co. 419					
Corrected Brix	15·47	16·90	18·31	18·79	17·66
Sucrose percentage	12·29	14·23	16·09	16·60	15·66
Glucose	1·72	1·12	0·84	0·70	0·82
Purity	79·51	84·20	87·22	88·42	88·60

It is seen from what has been presented in Table IV that bright and clear weather during a continued period of fairly low temperature with cool nights are conducive to crop maturity. Water, which has been a prime factor till October, becomes secondary. For nearly a couple of months the quality of the cane remains without any serious deterioration. It is during the harvest period (February—April) that days are windy and well-grown but poorly cropped crops lodge to the ground.

Integrated effect of climatic factors

From a study of the normal weather requirements of the crop presented above it is seen that the cane passes through three more or less well-defined phases. For each of these phases specific climatic conditions are required and unless the cane is so planted that the seasonal succession correponds with these requirements one or the other of the three crop phases are likely to suffer, viz. initial establishment, vegetative growth and juice concentration. It has, therefore, been well-said 'crops have long memories and they do not easily forget and seldom forgive neglect in their critical periods of growth.'

Although, the influence of each of the climatic factors on the performance of the crop is discernible in any given case, no single factor can be said to determine the final result, as all these react collectively and not individually. Such an integrated effect of all the climatic factors on the different growth phases of the crop has been graphically illustrated. From its study it is suggestive that all the phases of crop activity proceed simultaneously but only at varying rates, the process least favoured by the particular seasonal conditions taking place more slowly at that time.

Crop weather service

The interdependence of crop performance and climatic factors has now become more than plain. The labour, skill and dexterity of the farmer would at times fail to give the expected results mainly due to occasional violent fluctuations in seasonal conditions. To be forewarned is forearmed and its achievement lies in an effective mutual understanding of the meteorologist on one hand and the farmer on the other. As the weather warnings service requirements are specific to the crop and the locality, the Agricultural Meteorologist issued a detailed questionnaire in the hope of being informed of the weather service requirements for different crops and localities. An illustrative form of an answer to the questionnaire is the 'crop weather calendar' examples of which were given by Dr L. A. Ramdas in his article entitled whether Services for the Farmer.'* On similar lines a crop weather calendar in respect of the sugarcane crop of the Vizagapatam District has been prepared and presented in this paper.

**Indian Farming*, July, 1945.

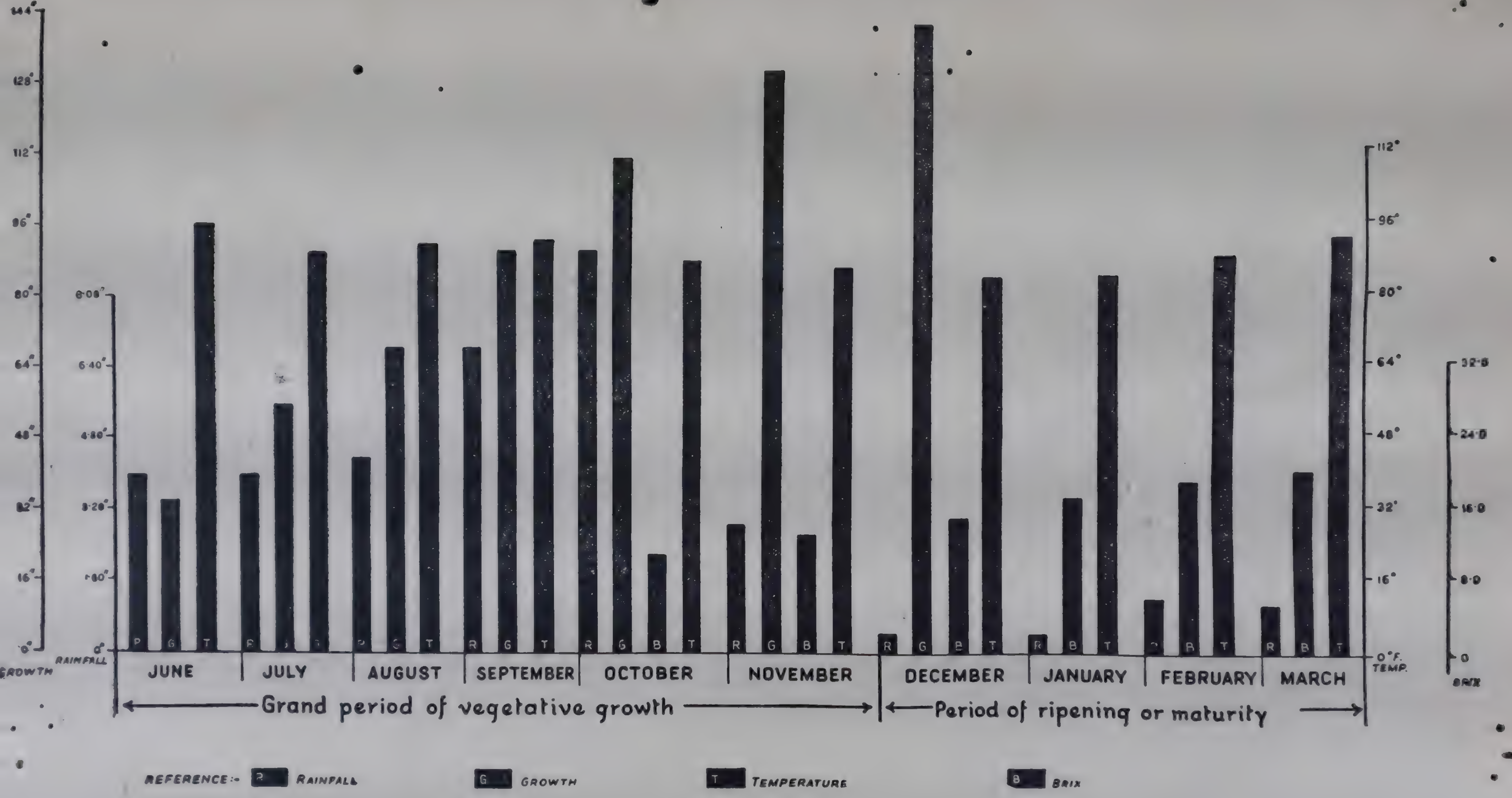

Fig. 1. Correlation of climatic factors and growth of sugarcane crop.

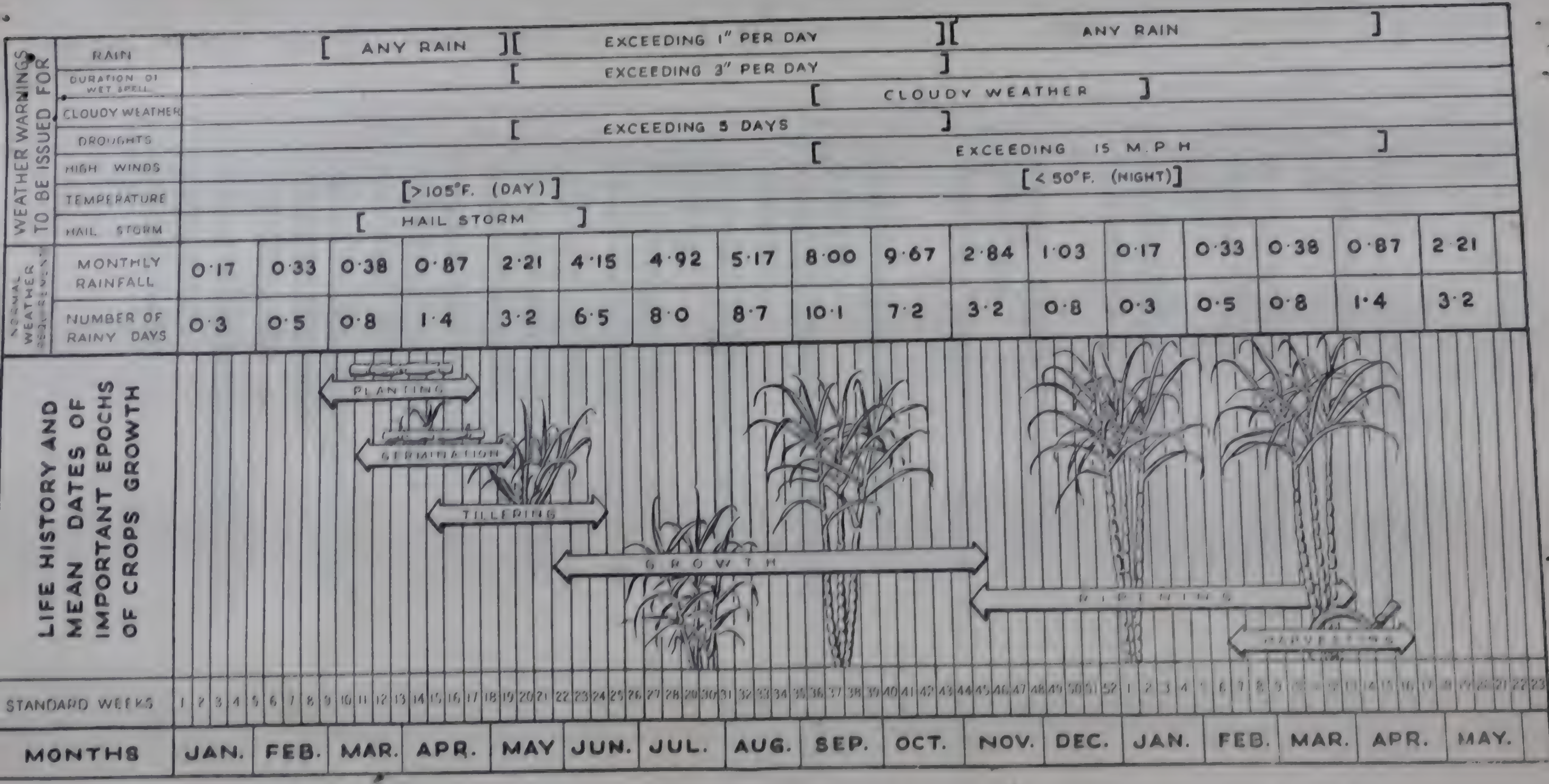

Fig 2. Crop weather calendar for sugarcane (Irrigated). Agricultural Research Station, Anakapalli, Vizagapatam District, Madras.

POSSIBILITIES OF INCREASING THE YIELD OF RICE BY RATOONING IN THE UNITED PROVINCES

By P. S. GUPTA AND A. K. MITRA

IN November, 1943, the Indian Council of Agricultural Research circulated notes from Bengal and Madras on the question of increasing the production of rice by (a) using the original rice stalk to produce a second crop and (b) interplanting of late maturing rice with early rice.

The two measures suggested above were given a trial as a means of stepping up production.

The observations given below pertain to the first aspect of the question only, i.e. whether it is a feasible proposition to increase production by using the original rice stalk to produce a second crop (i.e. ratooning).

Mr. P. W. Tsou claimed an additional harvest of 136,005 piculs (16.8 piculs =1 ton) from an area of 264,236 mows (6.59 mows=1 acre) in China during 1941 by this method. Ramiah in his *Handbook on Rice in Madras* records ratooning of rice in a very small area round about Chingleput. The information from Madras indicates an additional rice yield of 3 maunds per acre with Jeeragasamba and about 1 maund per acre from G. E. B. 24. The note from Bengal reports that *aus* paddy ratooning is done in a very localized area where it is not possible to grow a *rabi* crop after the *aus* paddy and that this method gives 5 to 10 per cent additional yields.

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Ratoon studies

Studies on rice ratooning were taken up at the Rice Research Station, Nagina during *kharif*, 1944. Since different varieties of rice are reported to differ in their ratooning capacity, it was of great importance to pick out the best ratooners from our selections before making a detailed study. For this purpose pure line cultures of our 170 early varieties were allowed to ratoon, care being taken to maintain a proper level of moisture in the field. A little sulphate of ammonia was applied in the early stages to help the secondary growth. The number of stalks which actually gave out shoots, and the yields from the second harvest were recorded.

It is interesting to note that out of 170 varieties under test only 16 gave some sort of an yield, the rest either did not produce any shoots at all or formed only sterile spikelets. All the stalks that were left over after the first harvest did not give out shoots. There was a wide variation in the number of ratooning stalks according to the variety. The range of the number of ratooning stalks varied from 14 per cent to 86 per cent of the original stalks. Only two (T. N. 32 and Ch. 10) out of a dozen early varieties, that are being multiplied in the Province, showed any capacity to ratoon and gave yields amounting to 9·47 per cent and 6·73 per cent respectively of the first crop. The variety T. N. 32 was thus picked out as a suitable one for further studies under field scale conditions. For this purpose a half-acre plot, from which T. N. 32 had just been harvested, was divided into two equal parts. One part was left to ratoon under irrigated condition, and the other half was allowed to ratoon under unirrigated condition. The latter treatment was essential because in the United Provinces, more than 90 per cent of the paddy crop is more or less wholly dependent on the monsoons, which, if it is unavailable by the end of September after the early varieties have been harvested, will leave the ratoon crop, if any, to grow under unirrigated conditions. The first crop of T.N. 32 from this plot gave an yield of 31 maunds per acre. Following this the ratoon under irrigated condition gave 2 maunds and 32 seers per acre or 9 per cent additional to the first crop. The ratoon under unirrigated condition gave only 35 seers per acre or about 3 per cent of the first crop.

The yields

As far as ratooning under irrigated conditions is concerned, it would appear that 9 per cent extra yield of paddy can be obtained which was just about the quantity this Province was short of before the war. But, as already pointed out above, 90 per cent of the paddy crop in the United Provinces is rain-fed and chances of getting a normal crop depend upon a favourable monsoon. Therefore when the main crop of rice is dependent on the vagaries of the monsoon, it is highly improbable that the ratoon crop would be irrigated from sources which do not exist at present. In the circumstances an increase of only 3 per cent or so can be expected over the first crop yield of the early variety in the Province. But early varieties comprise nearly two-thirds of the total area under the paddy crop in the Province, and contribute nearly [illegible] per cent to the total turn-out. Almost all the early paddy area is cropped with wheat, gram, pea, barley or other crops in the *rabi* season.

Ratooning paddy and rabi *sowings*

Ratooning of early paddy will naturally delay the *rabi* sowings. In the above tests with T. N. 32 the first crop was harvested on 6 September, 1944, in time for taking any *rabi* crop in rotation, and the ratoon was harvested on 3 November, 1944, nearly two months after the first crop.

In order, therefore, to study the effect of delayed sowing of a *rabi* crop on its yield an experimental trial was carried out in the following *kharif* with the treatments as indicated below:

1. Paddy followed by pea.
2. Paddy, paddy ratoon and pea.
3. Paddy followed by berseem.
4. Paddy, paddy ratoon and berseem.

T.N. 32 was transplanted on half an acre field, which was divided into six blocks of four plots. Under treatments 1 and 3, after the paddy was harvested, pea and berseem respectively were sown in the normal way. Under treatments 2 and 4, after the paddy was harvested, the stalks were allowed to ratoon under irrigated condition, and after the harvest of the ratoon crop, pea was sown in treatment 2 and berseem in treatment 4. The yields per acre obtained for different treatments are given in Table I.

TABLE I

Yield of paddy and rabi *crops with different treatments*

Treatments	Yield of paddy in lb.		Yield of a *rabi* crop in lb	
	First crop	Ratoon crop	Pea grain	Berseem fodder
1	1968	...	696	...
2	1767	8·5	169	...
3	1917	...	...	45870
4	1953	12·0	...	24109

It would be seen from Table I that under normal conditions (Treatments 1 and 3) 696 lb. of pea and 45870 lb. of berseem were obtained after T.N. 32 which yields respectively 1968 lb. and 1917 lb. But when the stalks were allowed to ratoon, before planting the main *rabi* crop, only 8.5 lb. of additional yield of paddy in one case and 12.0 lb. in the other were obtained. Against this small gain the yield of pea and berseem were very badly depreciated due to delayed sowings after harvesting the paddy ratoons.

In conditions obtaining in this Pro- with T.N. 32 respectively under irrigated and unirrigated conditions in 1944 and 0.4 per cent and 0.6 per cent (0.5 per cent average) was obtained in 1945. From these results it is clear that the increase in yield by ratooning that may be expected is not only of a very small order but is also extremely variable. Ratooning, thus, can only be of any advantage in areas where only a single crop of early paddy is taken, and where the soil has sufficient moisture to sustain a ratoon crop.

Conclusion

In a province like the United Provinces, therefore, where double cropping is the general rule, and in view of the adverse effects on the *rabi* harvest yields ratooning seems to be of hardly any significance.

FURTHER MANURIAL TRIALS WITH TOWN COMPOST, 1945-46

By C. N. ACHARYA

EXPERIMENTAL data on the manurial value of town compost are rather meagre. Two brief notes on the subject have appeared in the September, 1945 and June, 1947 issues of *Indian Farming*. The Provincial Departments of Agriculture in India are at present carrying out field trials in order to assess the value of town-refuse compost under their local conditions. Some of the preliminary reports that have been received, covering the period 1945-46, are summarized below.

Orissa

Trials on paddy at Parlakhimidi, applying 125 c. ft. (about 2½ tons) of compost per acre, gave an extra yield of 428 lb. paddy per acre, i.e. at the rate of 342 lb. per 100 c. ft. of manure applied.

Trials on *ragi*, under rain-fed conditions, showed an increased yield of 278 lb. per acre, i.e. at the rate of 169 lb. per 100 c. ft. of manure applied.

Other trials carried out at Berhampur, Parlakhimidi and Sambalpore with a number of vegetables showed that the application of town-refuse compost gave increases of 4517 lb. of potato (compost applied at the rate of 650 c. ft. per acre), 3822 lb. of cauliflower (600 c. ft. of compost per acre); there was an extra yield of 1371 lb. of brinjal (220 c. ft. of compost per acre) and 1131 lb. of cucumber (compost at 150 c. ft. per acre). These figures work out to an average extra yield of about 600 to 700 lb. of vegetables per 100 c. ft. of compost applied. Tobacco appeared to be specially responsive to compost, the application of compost at 150 c. ft. per acre increasing yield by about 670 lb. per acre.

United Provinces

At the Rice Research Station, Nagina, a trial was carried out during the *kharif* season, 1945, to compare the effects on paddy of: (a) ammonium sulphate, (b) town-refuse compost, (c) Acharya's farm compost, (d) Maya Das compost, and (e) Indore compost. Treatments (a) to (d) gave significantly higher yields than the control, the average increase being about 6 lb. of grain per pound of nitrogen applied in the manure.

A similar trial carried out at the same station in the same season, in order to compare different dosages of town-refuse compost, also showed that the compost applied at 150 lb. nitrogen per acre yielded 1407 lb. paddy as against 1207 lb. obtained at 100 lb. nitrogen level, 1021 lb. obtained at 50 lb. nitrogen level and 848 lb. obtained without any nitrogen application. The increased yield was roughly at the rate of 3½ to 4 lb. of extra grain, per pound of nitrogen applied.

Trials carried out on *jowar* at the Hardoi Farm and on wheat at the Meerut Farm gave similar increases of about 3 to 4 lb. of extra grain per pound of nitrogen applied.

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Bombay Province

During the *kharif* season, 1945-46, trials were carried out on *jowar* at the Government Farms at Surat, Jalgaon, and Dharwar, with a view to compare the effects of: (a) town-refuse compost at the rate of four cart loads (about 120 c. ft) per acre and (b) farm-yard manure at the same rate. The application of town-refuse compost increased yield by 104 lb. per acre at Surat (rainfall 64.97 in.), by 316 lb. per acre at Dharwar (rainfall 17.82 in.) but only by 13 lb. per acre at Jalgaon (rainfall 29.81 in). The straw was increased by 228 lb. per acre at Surat, by 1360 lb. per acre at Dharwar and by 1840 lb. per acre at Jalgaon. On the average 8.9 per cent increased yield of grain and 24.7 per cent increased yield of straw were obtained. The application of farm-yard manure increased the yield of grain by 2.8 per cent and of straw by 15.5 per cent.

Madras

An experiment carried out on *ragi* at the Central Farm, Coimbatore, in 1945, showed that an application of five tons of compost per acre gave a significant increase of about 15 per cent in yield over the unmanured plot, and that night-soil compost was equal in value to the farm-yard manure.

Bihar

The application of 50 maunds (about 100 c. ft.) of town-compost per acre at Tonto raised the yield of paddy from 12 to 16 maunds per acre; the application of a similar quantity of farm-yard manure increased the yield from 12 to 18 maunds per acre. A similar experiment carried out at Baihatu gave yields of 16 maunds per acre in the case of compost as well as of farm-yard manure, as against 13 maunds per acre obtained from the unmanured plot.

On the Sepaya Farm, town-compost at 40 lb. nitrogen per acre gave the highest yield of maize (15.8 maunds per acre), as compared to farmyard manure (yield 11.5 maunds per acre) and sulphate of ammonia (yield 10.1 maunds per acre). The unmanured plot gave a yield of 10.4 maunds per acre.

The results obtained on the Darbhanga Farm were similar: yield with town-compost was 16.6 maunds per acre, with farmyard manure 12 maunds per acre, with ammonium sulphate 14.5 maunds per acre, the unmanured plot giving 11.0 maunds per acre; all manures were applied at 40 lb. nitrogen per acre.

Conclusions

The trials, summarized above, indicate that the application of town-refuse compost exerts a significantly beneficial effect in increasing crop yield.

The increase in crop yield by the application of town-refuse compost is of the same order as that obtained by applying an equivalent quantity of well-made farm-yard manure in the case of cereals, and is distinctly higher than that with farm-yard manure in the case of vegetables.

The increased yield obtained by the application of 100 c. ft. of compost (i.e. about 50 maunds containing approximately 25 lb. nitrogen) per acre, is about 2 maunds extra grain and 4 to 6 maunds extra straw. In the case of vegetables for growing which round about towns urban compost is largely used, the increased yield is of the order of 8 to 10 maunds per acre for a dosage of 100 c. ft. of compost. Assuming an average return to the farmer, at price levels prevailing at present, of Rs. 7 to 8 per maund of grain, Re. 1 per maund of straw, and Rs. 4 to 5 per maund of vegetable, the extra yields mentioned above would warrant the assignment of a crop-producing value of about Rs. 20 per 100 c. ft. of compost in the case of cereals and of about double that amount in the case of vegetables. As against the above values, it may be noted that town-compost is generally sold at Municipal Depots at Rs. 2 to Rs. 3 per 100 c. ft. and the Government also offers considerable subsidy for transporting the manure from the Municipal Depots to the cultivators' fields.

NEED FOR THE DEVELOPMENT OF COLD STORAGE AND REFRIGERATED TRANSPORT INDUSTRY IN INDIA

By KIRPAL SINGH

THE preservation of foodstuffs collected during seasons of plenty for use in seasons of scarcity, has been practised by man from times immemorial. Thus, even the primitive man was alive to the need of preserving and processing foods either to tide over the difficult periods of famine or for use during off-seasons. The modern concept of storage, however, developed mainly for ensuring a balanced diet all the year round apart from the economic factor for maintaining a proper balance between supply and demand.

The most ancient method employed for the preservation of foodstuffs probably consisted of desiccation or the drying process but, with the progress of civilization, new and better methods were explored to preserve foodstuffs in as fresh a form as possible. The fact that readily perishable foodstuffs like butter, milk and meat, keep in good condition for a much longer period in cool weather than in the hot weather was known to mankind even in pre-historic days. In order to make use of this knowledge, man worked to evolve a method of producing low temperatures by artificial means. The use of liquified gases as a means of reducing temperatures has been known for more than a century, but the recognition of its commercial significance is a matter of the recent past when mechanical refrigeration was taken up in advanced countries of the world for preserving all the essential articles of food.

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Cold storage in the U.S.A.

Cold storage developments during the past half a century depict the progress of scientific and mechanical means of making perishable foods or food products available over a relatively long periods of time. The extent to which cold storage methods have been profitably employed in commercial operations in other advanced countries can hardly be over-estimated. The extent to which the inhabitants of the United States of America, for example, depend upon the cold storage industry is rightly expressed by an American scientist* thus: 'In the past thirty years, the use of mechanical refrigeration has grown so tremendously that no urban population in the United States could survive for more than thirty days or so without cold storage foods of one sort or the other. New York, I believe, could not live for more than ten days to two weeks at the utmost without cold storage foods.'

The cold storage industry in other countries has undoubtedly assumed great importance but it is sad to note that in India we are yet thinking to make a beginning in this direction. Despite the large volume of trade in perishable foodstuffs in our country, the methods employed in handling and storing such commodities are most primitive and highly inefficient. Fruits, vegetables, meat, fish, eggs, milk, etc. are stored in ordinary basements, godowns and rooms with no satisfactory arrangement for light, ventilation and sanitation and without proper devices to regulate temperature and humidity. No wonder, therefore, that large quantities of these nutritious foodstuffs are often spoilt because of the lack of facilities for proper storage, judicious marketing and adequate transport.

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* Birdseye, C. (1932). Quick Freezing and its Bearing on Transportation of Frosted Foods. *Month.. Pub. of N. E. Railroad Club. Boston Mass. Jour.* pp. 185-208.

Lack of appreciation

There appears to be a general lack of appreciation in our country of the vast potential utility of cold storage and refrigerated transport for the economic welfare of the people. There are bright prospects of a general rise in agricultural prosperity and a corresponding improvement in the standard of living of the people, if cold storage and refrigerated transport are properly developed as an industry. The phenomenal advancement in agricultural prosperity made in such enlightened countries as the United States, Canada, Australia, Argentina and the Union of South Africa, is, in no small measure, due to the development of the cold storage and refrigerated transport industry there. This industry provides facilities for economic transportation of agricultural produce to distant markets. The foodstuffs are either shipped direct to consuming markets in refrigerated holds or vans or are stored in refrigerated warehouses in seasons of plenty and steadily released as and when required. This practice obviates chances of a glut in the market and brings about extension of the marketing period of a particular commodity over a reasonably long time. The results are beneficial to the producer and the consumer alike—the producer gets a reasonble price for his produce and the consumer is assured of a steady supply of fresh commodities at moderate rates.

In contrast to the conditions prevailing in agriculturally advanced countries of the world, it is unfortunate that perishable foodstuffs produced in this country should rot for want of efficient handling and transportation. In spite of the fact that perishables worth millions of rupees are consumed each year, these indispensable commodities are handled roughly and are stored under insanitary conditions with the result that a considerable portion is wasted and the part, that is left over and is disposed of, is seldom free from contamination. The prevalence of at least some of our epidemic diseases may be traced to this cause. It is high time, therefore, that our methods of handling perishable foodstuffs should undergo a radical change and this is feasible only if the facilities inherent in cold storage development are properly exploited.

Refrigeration and fruit industry

The need of cold storage and refrigerated transport facilities is being generally felt for all the developing industries in perishable foodstuffs like dairy products, fish, meat and poultry. But, for the sound development of the fruit industry in this country such facilities are specially required. Little has hitherto been done to create a special demand for fresh fruits either by advertising or by offering them in attractive and fresh forms. The practice in vogue is to pluck the fruit as soon as it develops colour typical to its maturity and to push the entire crop into the neighbouring markets. The ripening period being of a short duration, the markets get flooded with commodities during the season far in excess of the demand. Thus, the producer gets a ridiculously low price for his produce and the consumer gets a particular commodity for a very limited period only. At times the supply outstrips the demand to such an extent that the producer is lucky if he can recover the haulage and other incidental expenses for his produce, to say nothing of its value.

Enormous waste

Numerous instances could be cited to show the enormous waste in the chief centres of production in our country due to improper marketing and transport. For instance, pears of superb quality are grown in the rich and fertile valleys of Kashmir and Kulu but the fruit seldom reaches even the adjoining markets, the possibility of sending it to distant places being of course put of question. The same is true of the numerous delicious varieties of banana which grow in enormous quantities on the Malabar coast. Custard apples of the finest quality grow wild in parts of the Central India, Bhopal and Hyderabad but the price they fetch is almost negligible. Yet this is a fruit which is held in high esteem and cannot be had in adequate quantities in the neighbouring tracts for the simple reason that the necessary organizations for storage, transport and marketing are lacking.

The grapes of Quetta, peaches and plums of the North-West Frontier Province, pears and apples of Kashmir and Kulu, Malta oranges of the Punjab, Sangtra oranges of Nagpur, pineapples of Assam and rich varieties of mangoes of the finest quality from Madras, Bombay, the United Provinces, Bihar and Bengal are all plentiful in their respective seasons. The period of availability of fresh fruit in each case, however, is so short that in the absence of proper storage and transportation facilities at the time of ripening of the fruit, a rich harvest, instead of proving a blessing to the cultivator, is not infrequently a financial liability.

Nearly six million tons of fruits are produced annually in our country (Report of the Central Land Utilization Sub-Committee of the Policy Committee No. V on Agriculture, Forests and Fisheries of the Reconstruction Committee, Government of India, Department of Education, Health and Lands). This production provides a fairly good material for a balanced diet for our people but in actual practice the fruit is beyond the reach of even the middle classes, the reason being that a large part of this production is actually wasted. Our problem is, therefore, not only 'How much more we can produce' but is also 'How can we equitably distribute what we already produce?'

Mutual advantage

It would appear, therefore, that cold storage is indispensable for the economic development of the fruit industry of a country. It is no exaggeration to say that the fruit industries in other countries would not have survived for any length of time but for the existence of up-to-date cold storage facilities. A large majority of fruits are readily perishable and, under atmospheric temperatures and humidity, cannot be stored without serious deterioration even for a few days. Cold storage plants help in extending the period of their availability, thereby reducing considerably the fluctuations in prices. In this way, reasonable prices are ensured to growers and chances of the dumping of fruit are obviated since it can be released from cold storage as and when required to meet the demand of the consumers. In short, therefore, the cold storage system works to the mutual advantage of the grower and the consumer and, in its absence, it would be idle to expect the development of the fruit industry on sound and profitable lines.

Just as the progress in the realm of applied electricity has been made not by accidental discoveries and chance inventions, but by careful study and persistent application of principles learnt in scientific research, so refrigeration is produced mechanically with apparatus designed and perfected by applying the known principles. The history of the refrigerating machine is a history of steady growth and development. As knowledge of physical and chemical laws became more extensive, particularly in respect of the behaviour of gases and heat transfers, the refrigerating machine has been improved upon and perfected. It is now being extensively used in various capacities from the smallest unit of a household refrigerator to a prodigious mechanism employed in commercial ice-manufacturing, cold storage and airconditioning plants.

THE MEXICAN OUTBREAK OF FOOT-AND-MOUTH DISEASE*

IN early November 1946 an outbreak of foot-and-mouth disease was reported to have broken out in Mexico on a ranch near the State of Vera Cruz. The disease rapidly spread into the adjoining States of Puebla, Hidalgo, Mexico, Tlaxcula and the Federal States. This outbreak was the result of importation into Mexico of 475 heads of zebu cattle from Brazil where foot-and-mouth is known to exist. One of the consignments of the cattle was stationed in the State of Vera Cruz where the disease occurred for the first time.

Control measures

The Mexican Government took immediate action and informed the United States Department of Agriculture about the disease. The United States Bureau of Animal Industry deputed two experts to cooperate with the Mexican authorities in diagnosing the infection. The disease was confirmed by all the officers of both the States.

The Mexican Government immediately started control measures and took the following precautions:

(a) A quarantine line was established around the infected zone which included all the area in which the disease was known to exist.

(b) A second quarantine zone was designated around the affected area to act as a buffer region between the infected and the uninfected areas.

(c) The quarantine lines were guarded by the Mexican Government troops.

(d) All the infected or exposed animals were destroyed in the first and the second zones.

(e) All the movements of the animals between the zones were stopped.

(f) All the sporadic cases in any area outside the quarantine zones were to be destroyed.

In spite of all the precautions listed above the disease continued to spread and some areas in the second zone were also affected. As a result the Mexican Government found it difficult to slaughter all the infected and exposed animals and to indemnify the owners. Consequently, both the United States and the Mexican Governments decided to set up a joint office at Mexico City to eradicate the disease and to prevent its further spread to other parts of Mexico and its entry into the United States.

After the establishment of this office the eradication work was stepped up. All the susceptible livestock in a zone of about 150—250 miles, round Mexico City, were slaughtered. It is estimated that from the beginning of the outbreak to the end of April, 1947 about 18,000 animals were slaughtered and buried. Slightly more than half of these were cattle, the remainder being sheep, hogs and goats. In addition to this about 75,000 apparently healthy animals have been sent to slaughter-houses in the main quarantine zone in the South-Eastern

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*Condensed from the *Journal of the American Veterinary Medical Association* whose courtesy is acknowledged for permission to publish the summary as well as the map accompanying it. The relevant issues of the *Journal* are CX (1947), 147-151; 224-225; 297-299; 365-366; and CX, (1947), 24-25.

Mexiso in accordance with the plans for reducing the number of susceptible livestock.

In order to avoid any breakdown in the agricultural operations of the areas which are involved, the Mexican Government with the assistance of the United States Government are using mules, which are not susceptible to the disease, in place of the cattle which are being disposed of. About 5,000 mules have already been employed and it is expected that another 30,000 will be needed. As a further measure to check the spread of the disease, all the susceptible wild animals which are potential carriers of the disease are being destroyed.

The United States Government have also provided full assistance by way of personnel. A section of the staff of the Bureau of Animal Industry, one hundred strong including thirty veterinarians, are working in collaboration with the Mexican Government officials. All the modern equipment that can be utilized to speed up the slaughter and burial of animals has been supplied by the United States.

Finance

The question of finance was a major problem as huge sums had to be paid as indemnities for the livestock that were slaughtered, and for maintaining the troops at the quarantine lines besides the cost of equipment, provision for salary, etc. In order to meet all the expenditure the two Governments at a joint meeting decided to contribute equal amounts; about nine million dollars (approximately Rs. 32 lacs) were earmarked by each Government to combat the disease till the end of June, 1947.

Results

Although the disease was not completely wiped out by the end of June it had definitely been controlled and no fresh outbreaks of the disease were found to occur in any part of Mexico. The nearest spot where the disease could touch was 350 miles from the United States—Mexico border.

The outbreak of foot-and-mouth disease had a special significance for the United States; first, because of a long common border and secondly, because of the large number of cattle which the United States Government imports from Mexico every year. It is estimated that during the period of actual importation of cattle in Mexico from Brazil and the occurrence of the outbreak approximately 151,800 cattle had entered the United States from Mexico.

In addition to all the precautions mentioned above in Mexico, the United States Department of Agriculture has urged the construction of a protective fence along the entire United States—Mexico border which is about 1,905 miles long. With the construction of this fence, all the unauthorized movements of cattle across the border is expected to be stopped.

Conclusions

The methods employed by both the Governments in jointly eradicating the disease have really been very remarkable. They have worked with the fullest cooperation to combat the infection and its spread to the non-infected parts of Mexico and the United States. Slaughtering of about 93,000 heads of cattle and other susceptible livestock, replacing them with mules, prompt payments of indemnities have all gone a long way to avert a great economic loss. The United States have a big livestock and animal products industry which would have suffered seriously if such vigilance was not shown by the two Governments. The idea of erecting a fence 1,905 miles long is a unique one. This fence, when complete, will be a solitary example of remarkable interest shown to protect the livestock industry of a country.

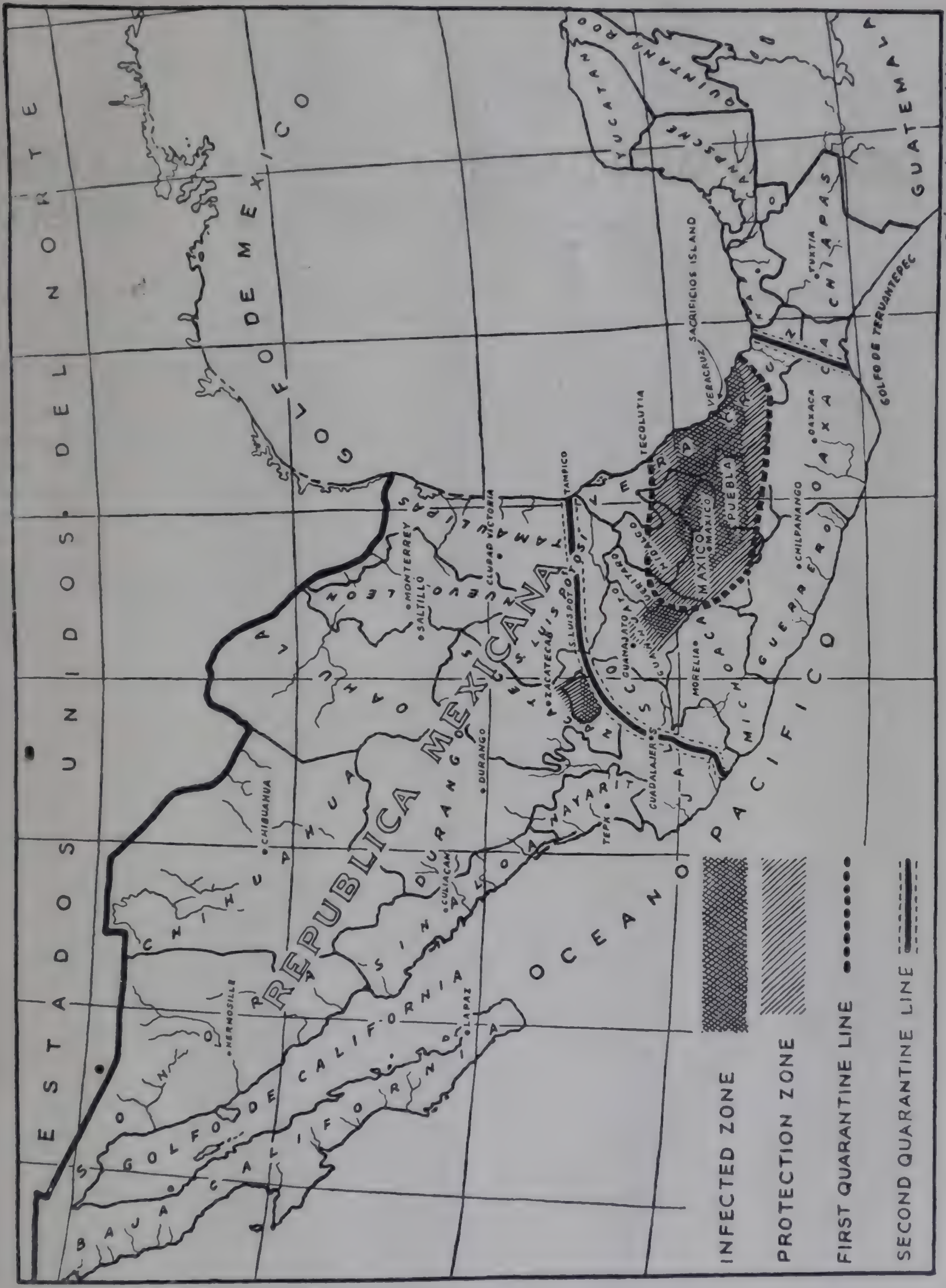
ESTADOS UNIDOS DEL NORTE
GOLFO DE MEXICO
OCEANO PACIFICO
REPUBLICA MEXICANA
GOLFO DE CALIFORNIA
BAJA CALIFORNIA
SONORA
CHIHUAHUA
COAHUILA
NUEVO LEON
TAMAULIPAS
SINALOA
DURANGO
ZACATECAS
S. LUIS POTOSI
NAYARIT
JALISCO
GUANAJUATO
QUERETARO
HIDALGO
MEXICO
PUEBLA
VERACRUZ
MICHOACAN
GUERRERO
OAXACA
CHIAPAS
TABASCO
CAMPECHE
YUCATAN
QUINTANA ROO
GUATEMALA
GOLFO DE TEHUANTEPEC
HERMOSILLO
CHIHUAHUA
CULIACAN
LA PAZ
DURANGO
MONTERREY
SALTILLO
CIUDAD VICTORIA
TAMPICO
ZACATECAS
S. LUIS POTOSI
TEPIC
GUADALAJARA
GUANAJUATO
MORELIA
MEXICO
PUEBLA
TECOLUTIA
VERACRUZ
SACRIFICIOS ISLAND
OAXACA
CHILPANANGO
TUXTIA
INFECTED ZONE
PROTECTION ZONE
FIRST QUARANTINE LINE
SECOND QUARANTINE LINE
Redrawn by N. S. Bish

Fig. 1. Control of an outbreak of foot and mouth disease in Mexico and U. S. A.

What the Scientists are Doing

DEVELOPMENT OF MILKING QUALITIES IN DRAUGHT BREED

AT the Government Cattle Farm, Hissar, a technique for measuring the draught ability of the bullocks was devised as part of a scheme to discover to what extent milking qualities can be developed in draught breeds without spoiling the latter quality. Experiments are also in progress to find out the correlation between the actual draught quality of a bullock and its various body measurements. The scheme for the improvement of the Kangayam breed at Madras has shown that the animals receiving pre-natal treatment in the form of massage of the udder and general rubbing have had a longer lactation period and yielded 45 per cent more milk than others. The Kangayam breed has been regarded as a purely draught breed, but the results of milk recording of the animals of the experimental herd have shown that there are individuals yielding over 4,500 lb. per lactation and at least 21 per cent of the recorded cows yield over 3,000 lb. per lactation, which is the minimum permissible for registration in the Central Herd Books for a milch breed like the Sahiwal. (I. C. A. R.)

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information is of general interest.

Q. Will you kindly let me know the conditions required for cold storage of potatoes, tomatoes and lemons?

A. Fresh fruits and vegetables intended for storage should be as free as possible from skin breaks and bruises; they should also be neither immature nor over ripe. If these precautions are not taken it may be difficult to keep them from too rapid deterioration in storage. The keeping quality under particular conditions of storage may slightly vary with the variety of a particular fruit or vegetable, but the proper conditions for each variety may be determined by experience. The following gives a general picture of the conditions required for cold storage of potatoes, tomatoes and lemons based on experiments conducted abroad.

Potato

The potatoes are stored for two purposes, viz. (i) for table use and (ii) for seed. Investigations have indicated that potatoes stored at 50°F. to 60°F. have better texture, colour and flavour when cooked or made into chips than the same stock stored at lower temperatures, although the higher temperatures are not suitable for long-time storage. When potatoes are stored at these temperatures sprouting will occur more quickly, but it can be checked by lowering the storage temperature.

At 40°F. potatoes remain dormant for 3 to 5 months after harvest and this temperature is suitable for storing table potatoes as well as seed potatoes for such a period.

If it is desired to keep them longer than this period, as is generally the case with seed stock, the temperature may be lowered to 36°F. or 38°F. at which they should remain dormant indefinitely. A storage temperature as low as 32°F. is detrimental.

The relative humidity of a potato storage house should be 85 to 90 per cent to prevent shrinkage through loss of water.

Potatoes intended for storage should be handled carefully to avoid bruises and cuts; otherwise, they are likely to be damaged by various forms of decay before the end of the storage period. Potatoes are generally kept in gunny bags for storage. Potato tubers of the varieties Phulwa and Gola might be available from growers in the province after harvest.

Tomato

Ripe tomatoes are held in storage only temporarily and should not be stored at temperatures below 40°F. At 40°F. to 50°F., if not already soft ripe, they will keep in good condition for a week to ten days; at temperatures lower than this they show a tendency to break down.

Green tomatoes are best kept at a temperature not lower than 55°F. At this temperature ripening progresses slowly but satisfactorily; mature green tomatoes can be kept for 3 to 5 weeks before becoming over-ripe. The relative humidity of tomato storage or tomato-ripening rooms should be from 80 to 85 per cent.

Lemons

The best results are usually obtained by storage at 55°F. to 58°F. in a relative humidity of 85 to 90 per cent. Under such conditions lemons can be expected to hold up satisfactorily for periods of one month to as long as four months depending upon their maturity and condition when stored. Tree-ripened lemons, which are yellow when picked, do not keep well in storage.

Lemons in storage should be examined frequently to avoid loss from the development of decay or other deterioration.

As regards availability of material and prices the local Agricultural Department may be consulted. (C.P.R.I.)

What's doing in All-India

BIHAR

B. N. SARKAR

IN the Bhagalpore and Patna Ranges, the rainfall during the quarter ending 31 March, 1947, was much below normal. In the Tirhut Range, it was quite irregular being insufficient in certain parts and excessive in some others. In the Chota Nagpur Districts, the rainfall at the beginning of the quarter was less than normal but this was more than made up during the latter half of the quarter. Briefly put, the effect of the rains in Patna and Bhagalpore Divisions was unfavourable to the growth of *rabi* crops although their harvesting and threshing were facilitated on this account. In the Tirhut Division too, the *rabi* crops suffered in growth in places of scanty rain while excessive rains in other places favoured the attack of rust in the wheat crop. The I. P. 52 variety was found to resist this attack much better than all the other improved varieties. In the Chota Nagpur Range, rains during the latter part of the quarter did some good to the *rabi* crops and sugarcane but severe hails, which accompanied the rains in many places, caused great harm to the *rabi* crops, Excessive rains in the latter half of the quarter as also the hails at some places, caused great havoc to the mango crop which was a complete failure in that range.

Harvesting of *rabi* crops was completed during the quarter and threshing thereof was in progress at the close of the period under review. Failure of rains, particularly in the earlier half of the quarter was responsible for unfavourable conditions at the time of sugarcane planting and the tardy germination of planted canes. This also had its effect on the standing cane crop leading to a rapid drop in juice purities in almost all factories. Sugar factories in Champaran recorded a severe drop in sugar recoveries for which the causes principally responsible were (a) the harmful practice of lopping of canes resorted to by the cultivators who however do so to alleviate fodder shortage in their localities and (b) the exceptionally high top-borer incidence. A large number of Sugarcane Seed Multiplication Centres were examined thoroughly for purity of the crop prior to its release to growers for further multiplication or general cultivation. Unapproved variety-plots were segregated and the crops harvested for an early crush in order to prevent mixing up. The Bihar-raised seedlings, N. O. 10 and B. O. 11, gave outstanding sugar recoveries. The recovery figure for B. O. 11 towards the end of March was 12.5 per cent as compared with 11.0 and 10.95 per cent respectively for Co. 313 and Co. 513. In the latter half of the quarter, particularly in high-moisture localities, the performance of Co. 453 was distinctly better than that of other standard varieties. It is estimated that the entire sugarcane area in Bihar will be saturated with Co. 453 and the outstanding Bihar varieties by the 1948-49 plantings.

B. N. SARKAR, O. B. E, is Director of Agriculture, Bihar, Patna.

THE TIRUPPUR REGIONAL CATTLE SHOW, 1947

K. P. DORAISWAMI

THE Tiruppur Regional Cattle Show, 1947, was held at Tiruppur in June, 1947.

The Cattle Show was declared open by the Hon'ble Sri K. Madhava Menon, Minister for Agriculture and Animal Husbandry, on 4 June, 1947, Sri V. C. Vellingiri Gounder, M.L.A., presiding. The Minister in a lucid speech stressed the need for such shows. Mrs. Madhava Menon urged women to take greater interest in livestock activities.

There were 238 exhibits in the Show in all. The exhibits on the whole were of good type, thus proving the great interest taken by animal husbandry men of this area in their cattle. In this connection it is well to remember that there is a Kangayam Breeder's Co-operative Society and a Kangayam Cattle Improvement Scheme working in these parts for the well-being of the local livestock in general and the Kangayam breed in particular.

Judging of animals was done on 5 June, 1947, and the judging was conducted by different groups of judges in two rings. The following are some of the important exhibits as per classification:

Classification	Total number of entries
1. Kangayam adult bulls	23
2. Kangayam young bulls	37
3. Kangayam bull calves	15
4. Kangayam adult cows	21
5. Kangayam heifers	16
6. Kangayam pair of bullocks	19
7. Horses above 14 hands	7
8. Mares above 14 hands	12
9. Ponies (male)	5
10. Ponies (female)	8
11. Murrah buffalo bulls	4
12. District Board bulls	18

In addition, a number of sheep and goats were also exhibited. A milking competition for Kangayam cows was also held.

Prizes

Apart from the prizes instituted by the All-India Cattle Show Society, the Tiruppur Cattle Show Committee awarded a number of prizes. Besides, eight rolling cups were also awarded for various important items.

The Hon'ble Sri. O. P. Ramaswami Reddiar, Premier, distributed the prizes on 6 June, 1947, the Hon'ble Sri. T. S. Avinashilingam Chettiar, Minister for Education, presiding. The Premier in his speech commended the enthusiasm of the ryots of the district in animal husbandry. He exhorted them to persevere in their work of building up a healthy stock of cattle.

Details of prizes awarded

Awarded by	Number of prizes	Value Rs.
1. The All-India Cattle Show Society	12	380
2. The Tiruppur Cattle Show Committee	63	842

A sum of Rs. 830 was contributed by the Provincial Government for the Show.

K. P. DORAISWAMI, G. M. V. C., is District Veterinary Officer, Madras.

General remarks

The Cattle Show was quite a success and evoked great appreciation from the ryots. This success was in a large measure due to the enthusiasm and active cooperation of Sri K. N. Palaniswami Gounder, President of the Cattle Show, Sri. V. C. Vellingiri Gounder, M.L.A. and a Member of the Provincial Livestock Improvement Board, Government of Madras, and other interested gentlemen. Mr. T. J. Hurley, the Director of Veterinary Services, Madras, and other Officers of the Veterinary Department, Municipal Board and other organizations were mostly responsible for the grand success of the Show.

One notable feature of this year's Show was the sporting offer made by the Pattagar of Palyakottai, a pre-eminent livestock breeder of our country, not to enter his famous Kangayam animals in the Show, in order to give the other breeders of the tract a chance to win prizes. This magnanimous action was highly appreciated, and has been a great incentive to the other livestock breeders of the district.

A SHORT HISTORY OF THE ANAMALLAI HILLS CATTLE SOCIETY

L. TOPHAM

THE Anamallais, or Poonachi Hills, as seen on any map, are situated in the Coimbatore District, South India. Pollachi is the nearest Railway Station, this being 42 miles away. The District is subject to both the monsoons, i.e. south-west and north-east, the former being heavy, and the latter light in comparison. Elevation is 3,500 ft. approximately.

Tea planting is the chief industry, but there is also a little coffee, cardamom and rubber. The District employs 60,000 to 65,000 labourers.

The Disrtict is divided up into Estates and Groups of Estates, each Estate of a Group having its own hospital with fully qualified medical staff, nurses, etc. and capable of dealing with the most critical cases.

At the moment of writing these notes there is only one out-let road, but by the end of the present year there will be an additional out-let road, leading direct into Cochin State, and terminating actually at Cochin. All roads throughout the District are suitable for motor traffic.

In the early days (20 to 23 years ago), cattle rearing was done in a very haphazard way. Cheap country cows could be bought for Rs. 15 to Rs. 20, which only gave a very meagre quantity of milk of very inferior quality. It was very exceptional to see a decent looking, sturdy animal.

The Society

The Anamallai Hills Cattle Society was started in the year 1933, and this was given every encouragement by the Estates in the District. Every facility was given to both staff and labour to keep cattle on the Estates. Sindhi bulls of good quality were purchased by the management through the good offices of the Government, and now practically all Estates have their own stud bulls to serve the cattle on the respective Estates. All Estates provide cattle-sheds for the housing of animals belonging to the labourers and the staff. Free grazing is permitted in the Estate swamps, where there is abundant grass. The amount of grazing varies, as is to be expected, some Estates being more fortunate than others in the amount of swamp land at their disposal. Herdsmen are provided by the Estate Management.

It is a pleasure to be able to state that the cattle in the District are now of exceptionally good quality, but it is regretted that at the moment the District is rather over-stocked; a few of the poorer class should therefore be thinned-out. Some Estates can claim 7/8th and 15/16ths Sindhi strain. The total head of cattle in the District is estimated to be 3,000 approximately.

Disease

The object of the Anamallai Hills Cattle Society is to improve the quality of the cattle in the District and also to control diseases. Every effort has been made to keep the District free from disease, but it has been proved that cattle brought into the District from the plains for slaughter are the chief offenders; so the Society at its own expense now provide a watchman at Attakatti, which is approximately half way between Pollachi and Valparai. Here there

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is a foot-bath through which all cattle must pass before being allowed to proceed into the District. All such cattle are examined by a fully qualified veterinary officer, and any found unfit or suffering from disease are refused permission to proceed. This method has in the past proved very effective, as imported cattle diseases, on the whole, have been very scarce. In a recent report on the cattle and pasture in the District, the following comments were made:

'Diseases of a non-contagious nature need timely care and treatment by a qualified veterinary surgeon. This can be had only when a Veterinary Assistant Surgeon is permanently stationed in the Anamallais in a convenient centre, with suitable accommodation and swift transport facilities.'

With the opening of the new out-let road to Cochin, I consider a similar foot-bath with a watchman in attendance will be necessary, but it is very doubtful if the Society, with its limited resources, will be able to afford this extra expenditure.

Finance

The Society is financed only by voluntary subscriptions from the individual Estates or Groups. The income is only sufficient to provide for very moderate expansion.

Veterinary service

Till about twelve months ago the District had a Resident Veterinary Officer, who could be called out to attend sick animals at a moment's notice. He was accommodated in an Estate bungalow by permission of the Manager. Unfortunately he had to leave the District as no Estate had a bungalow available owing to housing shortage.

It is hoped the Government, in the near future, will sanction building of a Veterinary Hospital in Valparai, for which Rs. 40,000 has already been sanctioned. This will certainly ease matters considerably.

Value of cattle in the district

While the cash value of this herd has been estimated to be at over Rs. 5 lacs at present, its potential value to South India as a milch herd, capable of raising the standard of milch cattle, is far greater.

Problems

The great problem at the moment is the lack of serviceable bulls, most bulls in the District are getting too old for service and others are known to have crossed their own progeny.

The situation regarding the supply of good quality Sindhi bulls is serious. Rather than allow the high quality of the animals now in this District to deteriorate, it is considered desirable that the Government of India should give every possible assistance to the Society regarding the purchase of new breeding stock.

Across the Borders

SOYBEANS

By W. D. KERLE

IN the first portion of this article, which appeared in the October 1947 issue of *Indian Farming*, the author described the manifold uses of the soybean plant and grain, the experience with the crop in this State, its soil and climatic requirements, and the few varieties which are available in this State.

The present instalment deals with the cultural and harvesting methods of the crop and the economic aspects of soybean growing.

After cultivation

The young seedlings cannot push through the ground if the surface is crusted with rain. It should be loosened with the harrows should this occur. It is also advisable to kill young weeds by harrowing before the seedlings appear, or it can be done after the plants are up across the rows in the heat of the day. Inter-row cultivations should be frequent enough to destroy weed growth when quite young. It is advisable not to throw a hill up to the beans as they bear the pods close to the ground; if the ground is kept level they can be cut with less loss when using mowers, etc. in harvesting.

Rotation

Soybeans are a valuable crop in a rotation. The beneficial effect on crops which succeed soybeans in a rotation is often very marked. This response has been most noticeable with winter cereals, maize, sorghum and lucerne. Until they can be established as a commercial crop, however, and seed is available at a reasonable price, they cannot very well be fitted economically into a rotation system.

Harvesting

Soybeans can be harvested for hay or ensilage from the time the pods are well-formed until the leaves begin to turn yellow. The main value of the hay, however, lies in its protein content; hence the best time is when the pods are well-filled out and at the first sign of the leaves yellowing. They are usually cut with the mower and allowed to wilt in the swath for a day or two, depending on weather conditions, raked and cocked. It will take a week to cure in good weather. Soybean hay is more difficult to make than cereal or lucerne hay, and loss of leaf is usual no matter how carefully it is handled. A reaper and binder can be used, but sheaves must not be too big or too tightly tied and stocks must be small.

Cutting for silage is done about the same time as for hay. It should be used in conjuction with maize or sorghum to save loss of protein.

Harvesting soybeans for grain is done when the beans are in the hard dough stage. This stage is reached when the leaves turn yellow and fall, leaving the bare stems with their clusters of pods. It should not be delayed until the leaves have all fallen, but commenced when about three-fourths of the leaves have dropped and most of the pods have turned colour, but the stems still green and pliable. If the crop is left too long, the pods burst and shed their seed, this is accentuated when mechanical cutters come in contact with the hard woody over-ripe stems. Shattering is largely a matter of variety, and some judgment is necessary to harvest at the best time to prevent loss. When the crop is harvested as in the U.S.A., with combined harvester and thresher or special bean harvesters the seed must be fully mature to get the best results. Weather conditions are also important, as in hot, dry weather more shattering and cracking will occur. Harvesting may also be done with the reaper and binder, but considerable loss of grain occurs. A mowing machine with side delivery attachment to prevent travelling on the swath is also satisfactory for soybean harvesting. The plants must be ‘ cocked ’ from the swath and left several days in the field to cure. The wheat header can be adapted for harvesting, but loss of grain occurs through inability to place the comb low enough to the ground.

The combined harvester and thresher is regarded in America as the best machine for harvesting soybeans from the standpoint of labour required, cost of operation and beans saved. Losses occur with these machines, chiefly at the cutter-bar, but also in threshing. Careful adjustment of cylinder, speed, concave sieves and blast are necessary to avoid loss by cracking, loss over racks and sieves, etc. Some loss in harvesting soybeans appears inevitable; the average loss even with specially adapted machinery being at least 5 per cent.

Soybeans that have been harvested by other than combine harvesters have, of course, to be threshed. The ordinary grain thresher can be used, but it must be adjusted for beans. The chief adjustment to prevent cracking is to reduce the cylinder speed by at least one half of normal rate for wheat. The special pea and bean thresher used for Navy and French bean seed is satisfactory for soybeans. The maize husker and shelter also make a good thresher for soybeans, although not fast.

Small quantities can be threshed with the flail or spread out on hessian and rolled out, after which they are winnowed.

Storage

Soybeans must be thoroughly dry when harvested otherwise they are liable to heat and mould. This is most likely to occur if seed is bulked in large quantities in badly ventilated sheds. Storage is safe in bags or bins in well-ventilated sheds if the moisture content is not more than 12 per cent. Weevils and rodents do not frequently cause damage of any consequence to soybeans in storage.

Yields

Yields vary very considerably, depending on variety, season and cultural methods. In the U.S.A. they vary from twenty to forty bushels per acre, but the average for the last ten years has been 16.4 bushels per acre. The highest average was 20.7 bushels per acre in 1939.

Although in test plots in this State, yields have been secured exceeding twenty bushels per acre, the average is nearer seven bushels per acre. In 1942-43, when soybeans were grown under contract to the Commonwealth Government, they averaged 1.2 bushels per acre on area sown. The season, however, was very dry, and some crops failed completely. The most successful grower in recent years is in the Armidale district, and he has averaged 10¼ bushels in the four seasons from 1941 to 1944. The area grown in this district in the 1945-46 season was thirty-four acres, and the yield just under seven bushels per acre.

Insect pests and diseases

No serious attack by insect pests has occurred in this State. In America they have also been comparatively free of damage from this cause. Grasshoppers, beetles, army worms, corn ear worms, and various caterpillars have caused damage in some years, and may cause more damage here as the acreage increases.

Serious diseases have not been noted as yet in soybeans grown in this State. They are, however, subject to various fungous diseases which might occur when soybeans are more extensively grown. Diseases which cause damage in other parts of the world, at times to a serious extent, are bacterial blight, sclerotial blight, pod and stem blight, downy mildew, alternaria leaf spot, mosaic and root rots. In diseases where the causal agent is seed borne, effective control measures can be applied. Selection of varieties resistant to the more serious diseases is desirable.

Use of soybeans

Apart from the uses of the soybean plant as a fodder, either as green feed, hay and silage or as a green manure, the uses of the grain are manifold. The amazing number of uses, which are increasing yearly, vary from food for humans and livestock to many industrial uses. In 1924 only about 6 per cent of soybean production in the U.S.A. was crushed for oil, but in 1940 it rose to 83 per cent. As a result of wartime needs, particularly of oil for which the American Government established guaranteed prices, production of soybeans rose from 106,712,000 bushels in 1941 to 210,000,000 bushels the following year. Soybean oil, due to its comparatively high iodine number, is classed among the semi-drying oils, and used extensively for paints and varnishes. It is used for soap making and candles and such varying products as glycerine, linoleum, celluloid, lecithin, printing ink, adhesives, rubber substitutes, cosmetics, etc. Refined soybean oil is used largely for edible purposes and in the manufacture of margarine and lard. In attempting to obtain a soybean oil having the drying properties of linseed oil, an inexpensive process for fractionating soybean oil into two parts has been developed recently. One of the parts is a relatively highly unsaturated oil with excellent drying properties, and the other is a relatively highly saturated oil with value as an edible oil.

The meal, after the oil is extracted, is an excellent stock feed. Soybeans as human food have many uses. Soybean flour is made use of in bread and other foods for diabetics. Breakfast foods, macaroni, bean curd, soy sauce and soy milk are other popular products of soybeans. The development of plastics from soybean meal has been extraordinarily successful. In the manufacture of plastics the oil must be thoroughly extracted from the meal by suitable solvents. It then contains from 44 to 48 per cent crude protein. Soybean plastics are being used in the manufacture of car bodies, car parts and for many articles in commerce. The soybean is a valuable source of casein. One of the most recent and important production of soybean protein is the making of a fibre resembling scoured wool. It has a warm soft feel, a natural crimp and a high degree of resiliency. Its tensile strength is about 80 per cent—compared with wool. It can be economically produced and can be handled on conventional cotton and worsted equipment.

Of recent years, suitable varieties of soybeans have been developed for use as a vegetable. The beans are pulled when fully developed in size, and the pods plunged into boiling water for two minutes to facilitate shelling. They are then cooked and used similarly to green peas. A number of these varieties have been tested in this State, and Easy Cook has given the best results.

The mature soybean is used extensively as a human food as a haricot bean, canned or as sprouts. Soybean milk, which can be satisfactorily made from the Haberlandt variety grown here, contains most of the same food elements as cow's milk, but in slightly smaller amounts. It can be used for practically all purposes for which cow milk is used. The chief uses of soybean grain in this State at present is for use as human food, either as cooked matured beans for canning or flour for manufacture of diabetic foods. A market awaits economical production of oil for paints and varnishes and for manufacture of plastics and other industrial uses.

Economic aspect of soybean growing

Soybeans cannot be recommended as a commercial crop in this State on the basis of prospective yield and pre-war import price. With the present limited experience of farmers in growing and handling the crop and with the varieties available a price of 25s. per bushel for prime quality beans would be necessary to make them comparable with other summer-growing crops. Apart from yield, soybeans are difficult to harvest without loss, even with modern harvesting and threshing machinery, and this adds considerably to the cost of production.

United States farmers have received the average equivalent Australian price of 5s. 10d. per bushel for soybeans in the last ten years, but the average yield has been 16½ bushels per acre.

For many years soybeans were grown in America primarily for hay, mostly where lucerne was not successful. In this State lucerne could be grown almost anywhere soybeans will grow, and has the added advantages of being perennial, easier to handle in hay making and can be grazed. In coastal areas, where green manuring is practised, especially in sugarcane districts, soybeans cannot be recommended in place of cowpeas. In the United States sowing soybeans in maize for hogging down or sheeping off is practised with very good results and should be of value in our coastal, tableland and south-western slopes maize areas.

If soybeans can be produced at a competitive price in Australia, there will be a big demand for the grain for many of the uses so popular in other countries of the world.—Reproduced from *Agricultural Gazette of New South Wales*, June 1947.

SOME IMPRESSIONS OF AGRICULTURE IN THE UNITED STATES OF AMERICA*

IT was my good fortune to be appointed a member of the Commonwealth Mission to investigate the soybean industry of the United States of America and Canada and subsequently to become a member of the Commonwealth Delegation to the Food and Agriculture Organization (F.A.O.) International Conference at Copenhagen, and to visit England. This involved 43,000 miles of travel by ship, aeroplane, motor car and train in 143 days, but such is the speed of modern transport, especially in the air, that I was able to spend seventeen days in Copenhagen, three weeks in London, and periods of from one to seven days in each of 24 cities in the United States and 15 in Canada. Naturally, this itinerary could not have been accomplished without persistent travelling by day and by night, covering long stretches by air, land and water.

The time at my disposal will not allow me to describe the rich colour of American life or to tell of my adventures among that teeming mass of 143 million human beings, including 12 million coloured people, that constitute present-day United States of America; nor can I give you an account of what it feels like to take a car with a left-hand drive into the Chicago loop district, noted for its exceptionally heavy traffic, after only two days' driving practice; nor do more than allude to the irritation one feels on picking up the *Chicago Herald Tribune* on Independence Day and reading, side by side with an announcement proclaiming the liberation of the Philippines, headlines adversely criticizing the Empire.

Of course, the American people are not all like that. I found them very interested in Australia and most willing to help the stranger within their gates. Nevertheless, one feels better on entering Canada and noticing on the roadside every few miles, a shield surmounted by a Crown and bearing the words, 'the King's Highway.'

Flying over the Atlantic, the North Sea, and the Pacific Ocean, were experiences at one time reserved for only the most daring pilots but now reduced to routine matter of fact travel, although I had one reminder that it is not always entirely routine when our plane while taking off for a flight of more than 1,700 miles over the ocean was pulled up after attaining full speed on the runway at Honolulu leaking petrol like a sieve. There is no time to expatiate on these things, but I feel bound to tell you of one incident which illustrates the sort of inversions one gets used to in the U.S.A.

It was a Sunday morning in Cheyenne, in Wyoming, one of the great sheep and cattle States. Snow lay on the ground two feet thick and the roofs of the houses and trees were plentifully sprinkled—a typical Christmas card scene. As I watched from the hotel window I heard the bells of the Church carillon play some beautiful tunes as the people entered the church. The last tune was 'God Save the King' and I thought it very broad-minded of the Americans to play it. Later, however, I discovered that the tune of 'God Save the King' has been borrowed and is the air of the patriotic song 'My country 'tis of thee.'

Seven thousand miles of the journey were accomplished by motor car in the great corn belt of U.S.A. and in its extensions across the Canadian border in Southern Ontario, among farmers whose interests are much the same as your own. In the course of this long journey I was privileged to meet leading scientists at six large universities, and at the United States and Canadian Departments of Agriculture and associated institutions. The country traversed is one of the richest agricultural regions on this earth and is very extensive.

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* An address delivered by H. A. Mullett, B. Agr. Sc., Director of Agriculture, at the Annual Conference of the Victorian Chamber of Agriculture, held at Colac on 18 March, 1947.

The soil for the most part resembles the black Wimmera soil, but the annual rainfall is greater, amounting to 36 inches, 20 of which fall in the summer.

Maize and soybeans grow to perfection on the same farms as wheat, oats, and barley, lucerne, and red clover. Practically every homestead is planted with fine oaks and elms, and there is a big barn to house the cattle in the winter.

Here the people do not move at the feverish rate they do in the big cities. They act and think more slowly and cling firmly to their traditional points of view. This is the great Middle West, the home of the Isolationist. Many of the people are deeply religious and bear little resemblance to the screen type of American. They live close to the soil and are not attracted by superficial glamour. They are the backbone of America, and among them Isolationism is now on the way out in the face of world events. Here is found a steady hostility to England, a legacy of the War of Independence.

The United States are very rich in natural resources—coal, iron, water-power, oil, non-ferrous metals and fertile productive soils. In area, it is almost identical with Australia, but instead of the well-watered fertile belt being confined to a few hundred miles of the coast, you find it also in the very heart of the country, 1,000 miles from the sea, comprising the valleys and plains watered by the Missouri and Mississippi rivers and their tributaries.

A rough parallel would be the Darling and the Murray carrying as much water as they do in flood, rising in snow covered mountains 10,000 feet high and flowing through millions of acres of fertile soil stretching from Queensland to the sea; as well-watered and as capable of producing crops as say the Lindenow flats in East Gippsland.

But there is one significant difference in that much of this area is deep in snow in winter and all stock have to be hand-fed from four to six months of the year, so that pastures as we have them, are not depended upon over this area for more than one-third of the feed of livestock at most. Contrast these U.S.A. production figures with our own:

	United States of America		Australia	
Maize	3,000,000,000	bushels	9,000,000	bushels
Oats	1,000,000,000	,,	19,000,000	,,
Wheat	900 to 1,000,000,000		120,00 ,000	,,
Horses	10,800,000	head	1,724,000	head
Cattle	66 000,000	,,	12,000,000	,,
Pigs	50,000,000	,,	1,500,000	,,
Sheep	66,000,000	,,	110,000,000	,,
Wool	443,960,000	lb.	1,127,860,000	lb.
Cotton	5,978,400,400	lb.	3,724,000	lb.

The destiny of Australia lies in increasing its human resources so that it can exploit its own natural resources to the full. In the U.S.A. we have a country which has already done this to a greater extent than will be possible here. The U.S.A. then, as in a mirror, gives a picture of the future development of this continent. There is much to learn that can with profit be applied here, and there are some things to avoid.

My outstanding impression of the U.S.A. is the importance placed on the sound development of agriculture by means of scientific research and in the success that has attended these efforts.

The present programme of research is immense in its scope. Each of the 48 States in the Union has a College of Agriculture of University rank. These colleges undertake three functions:

1. The training of students.
2. The conduct of research.
3. The dissemination of the research.

Each is separate from the Department of Agriculture and is set up on a grant of land provided by the Government, apart from the University proper. In each of these colleges agriculture is wedded to the Mechanic Arts, that is to say, in addition to a degree course in Agriculture, a degree in Agricultural Engineering is also given. I believe this to be an important factor in the American pre-eminence in agricultural mechanization. The colleges were originally set up by the Morell Act of 1862 under which substantial grants of land were made. Since that time they have expanded rapidly and now numerous courses are given. Practically all give a degree in Animal Husbandry, a subject which no Australian University School of Agriculture undertakes.

In the U.S.A. the settled policy is to concentrate the resources of the State and Federal Governments on one Agricultural College of University rank in each State. This is in order that there shall be one really first-class institution with first-class facilities in a first-class environment.

It is felt that such an institution has a powerful attraction for students, and so it has proved. To illustrate:

In the Agricultural College at Wisconsin, the principal dairying State, where over ten courses in specialized phases of agricultural science are given, there are 140 professors and associate professors. The student has the choice of a Degree in Plant Science, Animal Science or Social Science, or he may take a degree majoring in Agricultural Economics, Agriculture Equipment, Fertilizer, Grain Processing, Dairy Manufacture, Canning and so on. This institution, which is only the counterpart of many others, is set in an environment resembling the Melbourne Botanic Gardens. The building and facilities are an inspiration in themselves. These University Colleges of Agriculture throughout the U.S.A. are the Mecca of the young men from the country and city; they are well-attended and there is a strong demand for the graduates.

I would say of these institutions that, while their standard of scholarship is perhaps on the average not quite as high as at Australian universities, nevertheless they are much closer to the problems of the man on the land.

The research undertaken by these colleges is subsidized by the State and Federal Governments, and is wide in its scope, embracing the whole range of agriculture. By way of illustration let me mention the outstanding success which has attended the work of the plant breeder in improving quality and yields of crops and in breeding plants resistant to diseases.

The work of Professor Stakman and his co-workers in evolving wheat resistant to rust is well-known. Not so well-known is the work of the Canadian plant breeders in evolving ' Thatcher ' a wheat resistant to saw-fly, an insect which bores into the hollow wheat stem. The problem was solved by crossing ordinary hollow-stemmed wheat with a Durum wheat which has a semi-solid straw. This foiled the grub.

New varieties of maize are being constantly introduced and the use of hybrid corn in which the seed planted is the result of mating two inbred hybrids, is now wide-spread in the U.S.A. The seed is worth £1 Australian a bushel over ordinary seed maize. The average yield improvement is 20 per cent per acre.

By means of new tobacco varieties, the tobacco belt of the U.S.A. has been extended into Southern Ontario, Canada, and that country now not only supplies its own needs of tobacco but is a substantial exporter.

New varieties of soy bean have been evolved by selection and cross-breeding, which have substantially raised the yield and the oil content of the original varieties.

New varieties of soy bean have been raised which have practically eliminated the loss of yield due to the disease known as Curley Top from the Western States and to Leaf Spot in the east.

Beets which are single-seeded instead of multiple-seeded have been raised, as well as beets which can be sown in the autumn in Southern California without risk of 'bolting,' that is, running to seed in the spring.

Numerous new and improved potato varieties such as Katahdin and Sebago specially suited to the different localities, have been evolved.

In Victoria our plant-breeders are few in number and their work has been confined to cereals. It is most essential that their number should be augmented and a wider range of crops tackled.

On the animal side, much work is being done with the economics of feeding, the study of the influence of vitamins and hormones on health and productivity. There is also great activity in the scientific selection of elite stock for breeding purposes in dairy and beef cattle, pigs and poultry.

At Beltsville Research Station, the U.S. Department of Agriculture Animal Research Centre near Washington, I saw work of a revolutionary nature in progress. By means of crossing purebred dairy cattle, the yield of Friesian-Jersey-Red Danish crosses has been raised 20 per cent as compared with the purebred, due to what is called hybrid vigour. Work is also going on there with a synthetic hormone by which the body processes of animals are stimulated and production increased.

However, as Mr. Howey is to speak later on in the conferences to you on the subject of his enquiries into the Dairy Industry abroad, I will not elaborate further on this aspect. I wish, however, to make it clear that in the U.S.A. the farmer raising beef cattle, pigs and poultry, or producing milk or butter, has a wealth of specialized information on animal husbandry which has no parallel in this country, although on the disease control side there has been splendid progress in Australia.

The subject of maintenance of soil fertility and the prevention of loss by erosion has received serious attention in the U.S.A. Most experiment stations have well-planned experiments designed to furnish the basis data on these subjects. The results are of the utmost interest to farmers and there is now a well-developed soil conscience there. The period of 'soil mining,' which resulted in the impoverishment of so much fertile land, is now definitely over.

In the main corn belt, few crops of maize are sown without being preceded by a legume such as lucerne or red clover, and in addition, stable manure is carefully conserved and spread on the land.

The U.S.A. is specially vulnerable to soil erosion, more particularly of the water erosion type. Owing to the heavy snow over the greater part of the country, pastures are not highly productive, and hence maize, soy beans, tobacco and cotton, all of which are raised in rows, are widely grown. The fields were usually ploughed and cultivated down the slopes, and the heavy summer rains which are characteristic of much of the U.S.A. tend to wash the bare cultivated land into the rivers. This apparently is the case over much of the more hilly parts of the country.

It is estimated in Wisconsin that in the last 100 years from 5 to 12 inches of soil have been lost from an area of 9 million acres, and of this land three hundred thousand acres are now too denuded to crop.

Some wind erosion also occurs, particularly in dry areas of the U.S.A. and Canada exposed to wind. This is particularly true in Southern Alberta in Canada. Dr Duley and his co-workers in Lincoln Agricultural College, Nebraska, have evolved a system of 'trash' farming to control soil erosion, and elsewhere, methods of strip and contour farming have also been evolved to assist in combating it. Dr Duley demonstrates how the beating action of the rain pulverizes the soil crumbs, and how this fine material fills up the soil pores of the surface inch or two, thus increasing the run-off on slopes in moist areas. On loose soils in dry areas this fine soil is the soil that is lifted by the wind.

Dr Duley's remedy is to protect the surface of the soil from the beating action of the rain by leaving all crop residues on the surface instead of ploughing them in. This can be done in respect of both types of erosion by special types of implements that have been evolved, and what is more, the crop can be seeded despite the rubbish lying on the surface. However, so far, the bulk of the effort to control water erosion is by means of strip and contour farming.

At La Crosse Experiment Station at Wisconsin, and elsewhere, the rate of soil losses is being measured for varying systems of farming, including strip farming, on slopes of varying slopes and length. This basic data is fundamental to sound soil erosion advisory work and should be undertaken here.

It is one thing to solve an agricultural problem by scientific investigation and research and to prove the solution to be commercially feasible; it is another to have the solution widely adopted over the countryside. I estimate that there was a ten-year time lag before the top dressing discoveries of the Victorian Department of Agriculture were widely adopted in Victoria. This delay cost the farmers millions of pounds, and so it is in most countries.

In the U.S.A. a special organization has been set up to bring this knowledge to the farmers. In every county there is a county-agent whose business it is to bring the results of research to the farmers, and to lead the young men who will be the farmers of to-morrow.

The results of research are brought to the county agent by 'Subject matter—Extension workers' in contact with the research work. The counterparts here of these men are the Departmental experts, such as the pig expert, the sheep and wool expert, the cerealists and agrostologists, but so far we have in Victoria too few district agricultural officers, our nearest parallel to the county-agent of the United States. Compare the set-up in Victoria and the State of Nebraska as shown in the accompanying Table.

The total cost of extension work in the U.S.A. is 44,500,000 dollars. This is equivalent to 2s. per head of the population of which the State, Federal Government, and the County, each contribute approximately one-third.

In California there are 360 county-agents. In Victoria we are attempting to set up 18. So far, four have been appointed and two more appointments are pending. At the present time funds are not the barrier to progress, but rather a dearth of trained personnel. Now that the departmental salaries have been augmented and the number of students attending the university substantially increased, we stand a fair chance of securing the men required.

To sum up:

We need to intensify our drive for more agricultural education.

We need to concentrate our resources, not scatter them.

We need to increase our research especially in plant breeding.

We must watch our soil fertility, prevent erosion and obtain basic data.

We must augment our extension services.

Table showing comparison between the Agricultural Extension Services in Nebraska, U. S. A. and Victoria

	Nebraska	Victoria
Area (square miles)	77,000	88,00
Population	1,300,000	2,000,000
Value of Primary production ...	£109,000,000	£62,000,000
Cost of Agriculture extension ...	£205,000	£41,000
Federal contribution	£90,000	Nil
Cost of extension per head ...	3s.	11 d.
Subject matter extension workers ...	40	31
Administrative	13	2
County-agents	125	4
Total extension workers	178	37

Reproduced from the *Journal of the Department of Agriculture*, Victoria, May, 1947

Home Gleanings

INDIAN MARKET RESEARCH

By T. N. RASTAGI

MARKET research is a science of discovering the buying habits of the people, but to a student of industrial marketing it has a more extended meaning. To him, it connotes organized enquiry into the conditions which govern the marketing of the products—industrial and/or consumer—and the machinery to be adopted to satisfy the customers. It means, in the first place, a careful analysis of one's own sales figures in order to discover what factors, outside, have in the past influenced demand and are, therefore, likely to do so in the future. Price changes, alterations in terms, the competition of new lines, variations of the seasons—all these and other complex influences may be at work; and it is for the skilful statistician to disentangle their efforts. Secondly, market research includes the study on similar lines of any published statistics relating to one's own or kindred trades, as well as to business movements. Thirdly, it involves the initiation of special investigations or deliberate experiments in order to test the strength and weakness of one's products in public favour, to ascertain the qualities in new lines which are likely to meet the approval and the alterations in old ones which are required to bring them up to date, to assess the relative merits of various methods of distribution and, generally speaking, to obtain guidance in regard to any marketing question which can usefully be investigated on statistical lines. *Prima facie*, the need for such research is greater for oversea trade than for home trade, since the more remote the market, and the more complicated the conditions, the more difficult the marketing problem is to be, but, in our country, the home marketing policy necessitates more concentration in the post-war trading era on account of huge population, with good potentialities of development.

Marketing information is the first step in conducting market research. It represents the natural swing of the pendulum from concentration of manufacturing problems to marketing ones. Marketing information falls under three distinct heads which are as follows:

(1) Fundamental information, (2) statistical information and (3) particular information.

Let us discuss each item *seriatim*.

(1) *Fundamental information* : Under this fall all sorts of information concerning railway rate policy, transport system, political status, standard of living, tastes and habits of the people, legislation and other legal requirements for making the goods marketable. For example, if the goods to be marketed are branded goods, is there a prior registration of the name or mark? If not, what steps must be taken to obtain registration and what degree of protection does registration give, if it can be obtained.

(2) *Statistical information*: Here the information to be gathered will relate to the following subjects:

The population enumerated by races where different races exist; its social divisions; the characteristics and customs of the people; the latest statistics relating to vitality, public health, religion; the number of registered lawyers, doctors, school teachers, motor car owners, savings bank depositors; the state of public finance; the banking system; the currency; the rate of exchange; imports and exports; secondary numbers of livestock; the vegetable, fruit and animal products; the internal transport system, coastal and ocean steamship services; freight rates by land and sea, etc.

The significance of some of the items mentioned above may not be apparent at first sight. But trades differ, and one manufacturer will require to take some matters into consideration that others will not. An interesting experiment has taken place in the statistical investigation of a field, hitherto hardly explored, that of the retail and wholesale system of distribution. The United States of America has taken, first, a sample, and then a nation-wide, survey of the channel by which goods pass from the manufacturer into consumption, and the outlets by which they finally reach the consumer. This American numbering of shops and agents and the evaluation of the trade they conduct was due to a belief that business can be conducted more efficiently, if it is based on a thorough market study covering not only producers and consumers but the whole machinery or exchange. Manufacturers and their associations can use it in planning their marketing and sales policy. This affords an excellent example to the Government of India, Provincial Governments, Indian States, Indian Industrialists, and their associations to consider their collective and individual requirements in so far as the question of marketing the products is concerned.

(3) *Particular information*: This will be concerned with questions affecting the general working of the territory, such as, for example, the exact requirements of the market; the strength of the demand; the competition that newcomer to the market may have to meet from concerns already reputed there, the prices they obtain from local dealers on contracts and for ordinary routine sales; the mode of packing, the method of distribution and the advertising media.

The matters mentioned under the three heads above, or such of them as are relevant to the particular piece of research, may then be tabulated in the form of a questionnaire.

Such constant, controlled, research work would be of the greatest value to Indian manufacturers. They should be kept in constant touch with the needs and requirements of the public with their competitors' activities and with the probable trend of the market and if they rely entirely on their travelling agents, I am sorry to tell them that the busy traveller has neither the time nor, in general, the knowledge to look at the problem of marketing policy from any but his own special angle. Our Indian manufacturers would do well to supplement their travellers' reports and check them by their internal sales organization.

Market research will lead to a more exact equation of 'supply and demand' and to an elimination of many of the factors of waste in the process of distribution. The failure of some Government departments to understand the need of manufacturers as regards the publication of information which will be invaluable to manufacturers is also a major factor. Chambers of Commerce all over the country have on their files a mass of useful information. Much would result, if ways and means could be devised of circulating it to those who are in a position to use it to advantage. Many Indian manufacturers have acquired marketing information for their own use which might be circulated for the benefit of the business community, without complicating in any way their business problems and without the possibility of equipping a competitor with knowledge that could be used to the disadvantage of the manufacturer concerned. As the spirit of acceptance of scientific marketing grows in this counry, we shall see the linking up of the Government and municipal statistics with a much closer study of purchasing and living habits and with that will gradually come a change in the response of the people themselves towards enquiries about their own habits and tastes. Attempts of this type shall increase the commercial and industrial intelligence of India which in turn will bring about a balanced economic organization in order to solve the poverty problem.—Reproduced from *The Commerce*, August 17, 1946.

THE EARTH'S FACE: LANDSCAPE AND ITS RELATION TO THE HEALTH OF THE SOIL

By EHRENFRIED PFEIFFER, M.D. (Hon.), with a foreword by Sir R. George Stapledon, C.B.E., F.R.S. (Published by Faber and Faber, Ltd. 24, Russell Square, London, 12s. 6d).

DR Pfeiffer is the author of a number of books in which he has emphasized the biological and ecological aspects of agriculture and forestry. In this book he emphasizes the desirability of landscape consciousness in man and his responsibility in the shaping of his natural environment.

The scope of the subject treated will be illustrated from the following headings of the sections of the book:

1. Landscapes
2. Problems of the plain.
3. Problems of the mountains.
4. Problems of the woods
5. Urban civilization, industry and the landscape
6. Park and garden, beauty and utility
7. Some basic biological principles
8. Our past, present and future shaping of environment
9. Landscape consciousness and man's responsibility.

In his Foreword, Sir George Stapledon has pointed out that it is very much necessary 'to understand the deep significance of environment and fully to realize the extent of the destruction already wrought by man in his tamperings with the natural resources of the planet on which he lives' (page 8). The underlying theme of the book is that 'the mechanistic way of thinking must be replaced by living way of thinking.' The author emphasizes that in the utilization of the earth man should not disregard biological balance and the law of maintenance. He has illustrated his thesis by examples drawn from a wide range of subjects such as the harmonious blending in urban planning, of sites for industries and landscapes; soil conservation, afforestation and related subjects.

The author has wide experience, being himself a practical agriculturist, of farming conditions in many parts of the world. His wide travels have enabled him to use in his book a large number of instructive illustrations. With much of what the author has said scientific workers will be in agreement. There is, however, a certain amount of diffuseness and sometimes the conclusions are drawn in a general and vague way, which may convey a wrong impression to those, who are not thoroughly familiar with the subject matter. This criticism, however, does not detract from the merit of the book the main interest of which lies in stimulating thought on a very fundamental subject, namely, the necessity for the average citizen to realize his responsibility to his environment and the importance of ecology and biological balance. (J. N. M.)

* * *

SUGARCANE CULTIVATION (PRACTICAL SUGGESTIONS FOR SUGARCANE PLANTATIONS)

By K. M. Gururaja Rao, L. Ag., Retired Principal, Agricultural School, Hebbal, Bangalore (Published by the Bangalore Printing and Publishing Co., Ltd., Bangalore City, 1947, Rs. 4-8).

WITH the rapid development of the sugarcane industry in India there is a keen desire for knowledge regarding the details of cultivation necessary for this money crop. No doubt the experience and advice of practical cultivators and agricultural officers working on sugarcane on this matter are available, but they are scattered in numerous scientific publications, such as Reports, Memoirs, Bulletins and Pamphlets issued by the various Departments of Agriculture at the Centre and in the Provinces. The want of a clear-cut and concise book on the subject has long been felt by the large-scale planters as well as the petty cultivators. This gap has now very ably been filled by the author by the publication of this small book, which provides valuable and all round information in a compendious form.

The author has given a succinct but a clear-cut account of the principles of cultivation of sugarcane in the first seven chapters, practical suggestions for sugarcane plantations in the next seven chapters and very valuable and up to-date information in the form of Appendices I to XXIII and has provided a brief Bibliography at the end of the book. He has dealt with the various categories in a masterly fashion, which only a practical and experienced agricultural officer with an intimate knowledge of sugarcane cultivation can be expected to present in a balanced manner. The formula given by him at page 40 for estimating cane yields is of special interest. According to this formula, the yield of cane in a field can be estimated within a range of 2-3 per cent of the actual tonnage by the following data:

> 'Average height of cane of the field, in feet X number of canes per acre X weight in lb. per foot of cane=weight of cane in lb. per acre.''

The Foreword written by the great Sugarcane Wizard of India, Sir T. S. Venkatraman, bears sufficient testimony to the value of the book, the recommendations in which, according to him, 'are based on the actual experience of the author in the growing of large-scale plantations with all their difficulties, limitations and advantages.'

The author must be congratulated for his valuable production, a copy of which should be in the hands of all planters, sugarcane growers, industrialists and others interested in the cultivation of sugarcane in India. While issuing a second edition of this book, the author may incorporate more recent ideas, based on knowledge secured at experimental stations and plantations in Northern India, so as to make his work complete and of an all-India character. The author cannot, however, be congratulated for the way in which the 24 illustrations in his book have been reproduced, a fault more of the Printers than his own, but a better effort in this direction is needed in future editions of this book, so as to add to its aesthetic side. (R.D.B.).

News and Views

IRRIGATION BY ARTIFICIAL RAIN

By JOHN MANOR

IRRIGATION by artificial rain! Call it 'rain without clouds' or 'overhead irrigation'—it is mankind's latest weapon in the fight against drought and famine.

More, leading growers assert that even in a normal season this means of irrigation can double the output of a holding. Practical tests have proved that with two inches of artificial rain yields of carrots were increased by no less than 50 per cent. With four inches, the increase was as high as 80 per cent.

Rotating nozzle

With well-applied overhead irrigation the grower can work to a time-table and obtain high prices by supplying vegetables at a time which experience has shown to be an off-season so far as supplies from ordinary sources are concerned. He can, moreover, incorporate plant nutrients in regulated amounts in the artificial rain. If necessary, he can also incorporate insecticides should any pest threaten the crop.

In this system, water is forced through holes in a pipe line or sprayed from a rotating nozzle into the atmosphere and it descends in the form of rain. The land is never flooded. It is possible to inject compressed air into the supply so that the spray becomes a fine mist. There is no doubt that such oxygenated water has beneficial effects.

It goes without saying that an independent and ample supply of pure water is the first essential. Otherwise the supply is liable to be cut off at the period of greatest need. Electricity is probably the best form of power if the water has to be pumped, since motors can be set by time switch to run at night and fill reservoirs situated so that feed pipes can take water to the fields by gravitation. Careful planning of layout by qualified engineers is necessary to avoid waste of power and unnecessary piping.

Outstanding features

All rubbish and weeds should be cleared in advance from the area to be watered. If watering is in preparation for a second crop, it should be done in advance of cultivations.

There are at least half-a-dozen British firms specializing in overhead irrigation plant and some of them can boast of installations in every continent on holdings ranging from one to 1,000 acres. The main points of superiority of rain-making over flooding, for instance, are: economy of water; accurate control of amounts; obstacles of contour are overcome; less labour is needed once the plant is installed; no ground is taken up by ditches; fertilizers can be added; and no crust is formed on the land, as would be the case after flooding.

Perforated pipes

In one system of overhead irrigation movable units are used, the jet of water rotating a small wheel. This breaks up the jet into a fine spray and also causes the unit to rotate. In other systems, generally perforated pipes, in lengths of up to 300 feet, are used. Each system has its own special device for quick coupling and uncoupling of pipelines, since portability is essential. The pipe-lines are set out across the field on light tripods and moved when the required amount of rain has been produced.

Something like half-an-inch of rain can be put down in three hours, but speed and pressure can be varied according to needs. Provided water is available, there are few snags which cannot be overcome. (*B.I.S.*)

INDIA TO BE WORLD'S LAC RESEARCH CENTRE

THE Indian Lac Research Institute at Namkum, Ranchi will be made the world's centre for research work on lac according to the decision of the Governing Body of the Indian Lac Cess Committee which concluded its two-day meeting in Calcutta on December 9 (1947).

The research already in progress will cover the field of improved production of raw lac materials, new modifications of lac and extended use of lac. The meeting also decided to close down the Shellac Research Bureau in London.

Sir Datar Singh, Chairman of the Committee, who presided over the meeting acquainted the members of the Committee with his own impression of the London Shellac Research Bureau which he had inspected during his visit to the United Kingdom last summer.

The Committee felt that, with the growing advantage of air transport and quicker communication between India and outside world and improved facilities for obtaining scientific laboratory equipments, it was possible for the Indian Central Lac Research Institute to take over the functions of the Bureau. The Committee, however, recognized the need for liaison between the Research Institute at Namkum and users of lac, and also for trade publicity overseas, particularly in the U.S.A. which consumed 60 per cent of the total export of lac from India. The feasibility of utilizing through the Ministry of Commerce, Government of India, the good offices of the Indian Trade Commissioners in various countries for this purpose was discussed.

The intensive demonstration scheme, which was being operated by the Provincial Governments of Bihar, and the United Provinces and West Bengal for showing to villagers the improved methods of cultivation of lac, was given a further lease of life for one year during which time the Provincial Governments concerned would be expected to put up their revised schemes to the Committee.

The Committee went through the half yearly and annual reports on the activities of the Institute during the period April 1946 to September 1947. The reports revealed that despite the prices of shellac ruling very high, the demand for the commodity outside India was on an increase during this period. Twelve trainees including three from Indian States were under training at the Institute. Experiments on control of insect enemies of lac by the application of DDT, Gammexane and hot air treatment were also carried out. The financial position of the Committee which generally had been constantly deteriorating since 1941 showed a slight improvement during this period.

Other subjects discussed at the meeting included ways and means of effecting improvement in plantation at Namkum and cultivation of lac in Mako orchard and Orya forest. (*P. I. B.*)

NEW DRINKING METHOD FOR POULTY

THE problems investigated by the Council for Scientific and Industrial Research are infinitely varied. They range from a comprehensive survey of the wool industry to such unexpected items as the invention of improved drinking facilities for hens. This little problem proved to be quite intricate, but it has now been satisfactorily solved.

Poultry are liable to contract disease from stagnant drinking water. It was decided the industry needed a supply of running water for poultry that could be turned on and off on the self-service principle. A drinking fountain was designed to release water when the hen pecked it. Under practical test, the first hen rejected this manifestation of the march of progress, and preferred to die of thirst. The next invention did not require any effort on the part of the hen, but flowed so freely that pools of water defeated the purpose of the experiments. The third interested the hens enough for them to peck it, but refused to provide the water. Then at last science and ingenuity triumphed over all difficulties, and, by using a valve similar to that in a motor-car tyre, a drinking fountain was devised which the hens are not afraid to peck, and which provides fresh water only as required.

The Council has ordered 36 of these new fountains for installation at its experimental poultry farm at Werribee, near Melbourne. They represent the solution of one more of the many minor problems of the poultry industry.—Agricultural Newsletter, No. AGN/173.

COVER ILLUSTRATION

MIDST THE BREWING STORM

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 2
FEBRUARY 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR - 21.2.48
2.800

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The Indian Council of Agricultural Research does not accept responsibility for opinions or statements contained in contributed articles or in advertisements in this magazine.

Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London WC 2.

INDIAN FARMING

FEBRUARY, 1948

Vol. IX

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IN MEMORIAM

MAHATMA GANDHI is no more. On the evening of January 30, 1948, while on his way to the usual prayer meeting, he was fatally shot at New Delhi, the capital of India. A foul hand thus put an end to the life of the Father of the Nation, and one of the most outstanding figures in human history.

Born at Porbandar on October 2, 1869, in Kathiawar, he received school education in this country and later on went to England where he was called to the bar. His legal calling took him in 1893 to South Africa where he first conceived the idea of non-violence and *satyagraha* as weapons to fight wrong and aggression. The treatment meted out to Indians in South Africa greatly moved him and he began a crusade against various acts and legislative measures which denied the Indian settlers the rights of citizenship and restricted their freedom. Gandhiji had to fight against heavy odds but he, and his followers under his inspiration, never strayed from the path of truth and non-violence, and in the end his *satyagraha* campaign came to a victorious termination. As a result the Gandhi-Smuts Agreement was signed in 1914 and all the obnoxious acts were repealed and the demands of Indian settlers in South Africa were granted in full.

Victorious in South Africa, Gandhiji came back to India in 1915 and settled near Ahmedabad where he established an *ashram*, or a hermitage, at Sabarmati after a couple of years. This *ashram* was a school for training in *satyagraha* and was meant for people who were willing to accept the strictest mental and physical discipline and to put up with all sorts of privation. In this *ashram* there was no distinction of class or creed and it was here that Gandhiji began the congregational prayer that was so characteristic of him in later days. Having made his headquarters at Sabarmati, he travelled throughout the length and breadth of this vast country contacting people of different shades of opinion and of different social strata. In this way he came face to face with the hungry, half-clad, dumb millions that real India is, the stricken, ignorant and exploited masses. He learnt to understand their mental make-up and to sympathize with their ideals and aspirations. He thus came to know the heart of India and was transformed into the person who always had his hand on the pulse of the nation. He realized the appalling poverty of the Indian masses and was eager to devise measures which would help remove this poverty and make every Indian healthy, happy and contented. To this end he commended the *charkha*, or spinning wheel, which today provides work for idle hours in countless homes and is looked upon as the symbol of prosperity and economic well-being. And, as a matter of fact, *charkha* and *khaddar*, the hand-spun and hand-woven textile, have been inseparably connected with the Indian freedom movement.

He stood by the weak, the oppressed and the down-trodden and a call to action came early. The scene was Champaran in Bihar. Here the poor and simple peasants stood up against the might of the British indigo planters. Gandhiji championed the cause of the peasants and led them successfully in their struggle. The planters had to yield. This was probably the first time that Gandhiji trained Indian peasants in the technique of *satyagraha* and non-violence.

Soon after the First World War, the Rowlatt Act was passed; it restricted the rights of the people in various ways. Gandhiji's passion for freedom, his great dislike to curtailment of one's legitimate rights spurred him to action and country-wide protests were organized. The massacre by British troops at Jalianwalla Bagh followed in 1919 and the fearful days of the martial law regime in the Punjab.

Gandhiji's position at the helm of the Indian National Congress became unassailable. In fact as years rolled by, it became more and more apparent that *he* was the Congress, although in later years he was not even an ordinary member of the organization. In 1920 he made common cause with Muslim League's *Khilafat* agitation and launched the first India-wide non-cooperation movement against the Government. This movement he all along wanted to remain strictly non-violent but, in spite of his teachings and directions, violence broke out in certain places notably at Chauri Choura in the United Provinces in 1922. He was a man who never eschewed violence or falsehood, and he was the first to admit that the country was not morally prepared for the great movement he had initiated. He fasted for days to atone for the guilt of his people and finally withdrew the movement. He was however arrested and sentenced to six years' imprisonment. It is worthwhile recalling the judge's estimate of Gandhiji, who tried and sentenced him thus :

> '....It will be impossible to ignore the fact that you are in a different category from any person I have ever tried or am likely to have to try....in the eyes of millions of your countrymen, you are a great patriot and a great leader. Even those who differ from you in politics look upon you as a man of high ideals and of noble and even saintly life.'

Before the expiry of his sentence he was released on grounds of ill-health in 1924.

The country at that time was passing through a period of frustration and communal disturbances had broken out at many places. Gandhiji, hardly recovered as yet from the after-effects of a surgical operation for appendicitis, undertook a fast for 21 days to restore communal harmony. The next few years, before the second freedom movement he launched in 1930, are to be looked upon as a period of preparation with stress on constructive programme relating to the attainment of Hindu-Muslim unity, abolition of untouchability and development of cottage industries, specially *khaddar*.

The campaign in 1930 was initiated by his famous march to the salt depot at Dandi to defy the salt law. He was arrested and put in prison. He was subsequently released and the movement was put a stop to by what is known as the Gandhi-Irwin Pact after the conclusion of which in 1931 Gandhiji was persuaded to attend the Second Round Table Conference. He went there as the sole representative of the Congress.

From the Yeravda jail to St. James's Palace was a long way indeed. But Gandhiji returned to this country empty-handed only to find that the various terms of the Gandhi-Irwin Pact were being violated. He sought an interview with the Viceroy, but instead he was arrested early in January, 1932, and imprisoned. While confined in the Yeravda jail Gandhiji undertook a fast unto death in order to effect a revision of the Communal Award given by Mr. Ramsay MacDonald. The Award sought to drive a political wedge between the two sections of the Hindu community. The fast lasted for a few days, from 20 to 26 September, 1932, and terminated with the signing of the Poona Pact. Still in prison on 8 May, 1933, he undertook a three weeks' fast for self-purification, but the Government released him on the first day of the self-imposed penance. Gandhiji then disbanded his ashram at Sabarmati and replaced the programme of mass movement by individual civil disobedience. He was again arrested and, while in prison, he was denied proper facilities for continuing work relating to the uplift of Harijans or untouchables; because of this, he started another fast but, after a few days, the Government released him.

Henceforth Gandhiji began to devote increasingly greater attention to Harijan work. In 1936 he established his new headquarters at Sevagram, Wardha, and from there he inspired or initiated constructive work in various directions for the welfare of the nation. His interest embraced such diverse activities as the Harijan movement, rural development, cow protection, cottage industries and even some phases of education among others.

In 1939 the Second World War broke out. India was dragged into this war without even being given an opportunity to express her opinion on the issue. In deference to Gandhiji's wishes the Congress ministries in the

Provinces tendered their resignation.

In 1940 Gandhiji restarted the individual civil disobedience campaign. With the Japanese armed forces advancing on the eastern frontiers of India, Sir Stafford Cripps was deputed by the British War Cabinet to negotiate with the Indian leaders a formula for solving the country's political stalemate. The 'Cripps Offer' was found unacceptable—in fact Gandhiji pronounced it to be a 'post-dated cheque. Gandhiji demanded withdrawal of the British and transfer of power to responsible Indian Government forthwith. But this was not heeded to, and in 1942 in the fateful month of August the Congress adopted the 'Quit India' resolution and Gandhiji inspired the people by his 'Do or Die' message. On 9 August all top-ranking Congress leaders were arrested. Gandhiji was detained at the Aga Khan Palace. There on 10 February, 1943 he began a 21 days' fast and survived the ordeal. And there too on 22 February, 1944, he lost his wife and life-long companion, Kasturba, who stood by him faithfully in all his multifarious activities, his campaigns and sufferings. Gandhiji was released on 6 May, 1944.

A Cabinet Mission came out to India in 1946 to work out an acceptable formula for the transfer of power; Mahatma Gandhi played a prominent part in the negotiations that followed. Contrary to his cherished desire the country was divided and on 15 August, 1947, the British quitted handing over power to the Governments of two newly created Dominions, India and Pakistan.

During the last several years Gandhiji was much pained at the growing communal unrest in the country and he rendered yeoman's service in combating this evil. He went to Noakhali on a peace pilgrimage to pursuade an angry crowd to grant the minority community its due. From Noakhali he went to Bihar with the same message, from Bihar to Calcutta. His great moral influence at these places, notably at Calcutta where he undertook a fast for the purpose, went a long way in bringing back sanity among people and restoring peace and communal harmony. He had contemplated a long peace tour to some of the provinces in Western Pakistan but was compelled to stay at Delhi where his presence was needed to allay communal tension. He had just recovered from the effects of a fast he had undertaken to bring about a peaceful atmosphere in India's capital, when on the evening of January 30, 1948, a mad assassin shot him dead.

A large rounded head on a bony frame with rather longish limbs—this puny man stood as a symbol of India as a whole. His bewitching smile, his winning manners, his shining eyes—no one who has either seen him or talked to him can forget. Reducing his needs to the level of the average Indian villager, this 'naked fakir'—as Britain's warrior-statesman Mr Winston Churchill contemptuously described him—stood against the forces of a mighty empire. Indeed his life for the long stretch of the last several decades is synonymous with the history of India s struggle for freedom. His individual identity was so completely merged in the cause of the country, that his was indeed the voice of India. To an extent unknown before he had endeared himself to the people, —to the teeming millions he was Bapu, the father. He fought for swaraj or freedom of the country. To him swaraj meant an all-round freedom for every one—a condition in which the rich and the poor, irrespective of caste or creed, would find equal opportunities for material and moral development. In the swaraj of his conception the weak, the lame or the halt would not find himself left behind or neglected.

More than anything else he depended on his 'inner voice' to guide him. He had no weapons other than non-violence and truth; on these he placed implicit reliance throughout his life. He conceived non-violence in deed as well as in thought as the highest form of bravery, and the only means of counteracting evil forces. He was an adherent of truth. He experimented with truth throughout his life and judged his activities in the light of truth and non-violence. To him end did not justify the means; purity of purpose and purity of means for attaining the purpose were to him equally important. His application of non-violence and truth to large-scale mass movements for solving political problems is unique and has a significant message for the war-worn world and the humanity at large. His humanism was all-embracing; to him caste, creed or colour did not matter at all. Said he:

> 'There is only one God for us all, whether we find him through the Bible, the

> Koran, the Gita, the Zend Avesta or the Talmud and He is the God of love and truth'.

He had his own sense of values and measured human activity, whether of the society or the individual, in terms of these. Born in a machine-dominated age, he did not hesitate to say that man should not be a slave to his inventions nor to point out that the solution of many of the present day economic ills lay in the production by the masses rather than in mass production.

The ethical principles which Gandhiji formulated were no doubt put to test and experimented upon within the geographical limits of India. But that does not preclude their application in wider spheres beyond. In fact historical, economic and social stresses have so circumscribed the world today that what is true here is true elsewhere too, may be with slight alteration or adaptation. There was an element of universality in his teachings and therein lies the essence of their appeal to different, and even mutually exclusive, individuals or groups of men in remotest corners of the world; this is also the reason why he has been acclaimed as one of the great leaders of thought and action produced so far.

In the dust and din of the political conflict and the quick-changing panorama of life, Gandhiji's creative contribution in various fields of activity are apt to be overlooked. Special mention may be made of his achievements in the realm of journalism and literature. Gandhiji had been associated with a number of journals as an editor and has been a prolific writer. Simple in language and graceful in style, much of his writings have a permanent value and will undoubtedly stand the test of time. His writings are records of his teachings and thought-processes and the enormous literature which he has produced will inspire generations to come and guide the future 'seekers after truth' on the high road of Gandhian philosophy and culture.

There are very few instances of men like Mahatma Gandhi in the whole range of human history. He stands with Socrates who had to drink hemlock for teaching his philosophy, or Jesus Christ, who embraced death on the cross for preaching his Gospel.

In more recent times a parallel is offered by Abraham Lincoln, the President of the United States, who was assassinated in spite of his great and good work for the Union and the emancipation of Negro slaves.

Of Mahatma Gandhi it may be said without fear of contradiction that 'he came not be ministered unto but to minister and to give his life a ransom for the sake of many'. As the great scientist-philosopher Professor Einstein has said:

> 'Generations to come, it may be, will scarcely believe that such a man as this ever in flesh and blood walked upon this earth'.

Original Articles

SUGAR INDUSTRY IN INDIA*

By SIR DATAR SINGH

IT is believed that India is the original home of sugarcane. From very ancient times, *gur*, *khandsari* sugar and even crystallized sugar were made and used in this country. The antiquity of the Indian sugar industry of some sort is, therefore, a matter of common knowledge. It is nothing but an irony of fate that for more than many generations this country had to import almost the whole of her white sugar requirements from foreign countries. For a long time indeed, Java had been playing a very important part in dumping most of her surplus sugar into this country, at a cheaper price than the factory-sugar produced in India. Such imports from Java and other foreign countries come to about a million tons of sugar per year, causing a large drain on the country, to the tune of about 15 crores of rupees per year.

As a result of the policy of discriminating protection, however, the white sugar industry in India has been revolutionized since 1932. From a country mainly dependent on imports of white sugar, India has now become one of the largest sugar producing countries in the world. In fact, if the productions of sugar and *gur* are considered together, India can today claim to be the largest single sugar-producing country. The industry has taken great strides in its development, but the period of this development, starting in 1931-32, almost terminated in 1939-40 due to various reasons, after which the progress has remained rather slow and, in fact, the sugar production in India is again going down gradually.

The development of the modern sugar industry, on its present scale, has taken place in three stages, which may be summarized as follows:

(i) A few small factories in Northern India, with practically inexpensive machinery, were started at the close of the nineteenth and the beginning of the twentieth century. The efficiency of such factories was necessarily low, with the result that not more than 65 per cent of the sugar contained in sugarcane could be extracted in these factories;

(ii) the erection of eight new sugar factories in which about 80 per cent of the sugar in the cane could be transformed into refined sugar, was effected due to the high prices of sugar prevailing during the time, i.e. about the end of the first Great War, but with the fall in sugar prices, further development was soon retarded; and

(iii) the industry was revived on a wide scale after the grant of the fiscal protection in 1932 by the Government of India. This protection was given to the sugar industry by the imposition of heavy import duty on sugar, thus curtailing and almost eliminating imports of sugar from Java and other foreign countries.

The development of the sugar industry has been possible only because of its nationalistic character and more so due to the grant of fiscal protection given to it. Given proper care and attention, this industry is likely to play a still more important role in the future economy of the country by a steady and well-dispersed expansion.

Protective duty on sugar

The grant of this fiscal protection is perhaps one of the greatest landmarks in the history of the Indian sugar industry. For the present, this fiscal protection has been extended up to the end of the current financial year and it is expected that the Government of India will again review the position very shortly as to whether further protection is or is not necessary. The Government's policy has always been to encourage and promote rapid industrialization to the fullest extent. Although tariffs are essential, and in some cases indispensable, for the promotion of industries, it must be admitted that they are not in themselves always considered to be a necessary source of protection, and hence opinions vary in this country as to whether an extension of protection is still desirable.

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* Lecture delivered by Sardar Bahadur Sir Datar Singh at the Delhi College of Commerce on 1 December 1947.

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The amount of protective duty on sugar fixed under the Act of 1939 was Rs. 6-12 per cwt., to which was added a countervailing duty equal to the excise duty. The excise duty was raised from Rs. 2 to Rs. 3 per cwt. in April 1940. The total import duty from April 1940, therefore, became Rs. 9-12 per cwt. A sur-charge of 20 per cent was added to this in April 1942, whereby the total import duty came to Rs. 11 and annas $11\frac{1}{5}$ per cwt.

With the grant of protection, the number of vacuum-pan factories have increased very rapidly from 32 in 1931-32 to 57 in the next year and went up to 154 in 1945-46, out of which 145 factories functioned in 1945-46 and 140 in 1946-47. The sugar refineries, on the other hand, numbered 17 in 1931-32, 27 in 1932-33 and declined to 3 in 1944-45. Similarly, the total production of sugar has increased from 1·58 lac tons in 1931-32 to 12·42 lac tons in 1939-40, which was the maximum quantity of sugar produced in the country during any year so far, but in 1945-46 only 9·45 lac tons were produced. The net imports of sugar by seas have in consequence, gradually come down from about 4·39 lac tons in 1931-32 to 8 thousand tons in 1942-43 and now consists of very small and negligible quantities and that too mainly of fancy sugars, etc. showing that, the industry at present has no foreign competition to face.

Sugar consumption in India

The average annual consumption of white sugar in India, in the pre-war period, varied roughly from 10·5 to 11·5 lac tons. The peak of sugar consumption was reached in the year 1939-40 with 12·42 lac tons of factory-made sugar. Various factors have in the last few years increased the sugar-mindedness of the people perceptibly. It is estimated that the future demand for sugar will be about 16·5 lakh tons per annum, if not more. Although India is the largest sugar plus *gur* producing country in the world, her *per capita* consumption is extremely low, paradoxical as it may seem. On the average, the *per capita* consumption in India amounts to only 6·5 lb. of white sugar and 20 lb. of *gur*, i.e. 26·5 lb. of total sugar per head, per year, as against a consumption of 106 lb. in the United Kingdom, 97 lb. in the United States of America, 160 lb. in Australia, 88 lb. in Cuba and 47 lb. per head, per year, in South Africa. The quantity of sugar per diem per adult required in a well-balanced diet is about 2 oz. so that at least 46 lb. of sugar per adult per annum is necessary. There appears, therefore, to be much room in the country not only to produce more sugar but also to eat more sugar.

Sugar production in India

During the pre-protection period, the production of sugar, including *gur* in India, approximated to about 15 per cent of the total sugar production in the world, whereas in 1945-46 this had increased to approximately 23 per cent. A peak production of 12·42 lac tons of factory-made sugar was achieved in the year 1939-40, but the quantity now produced in the country is hardly sufficient for internal consumption. Under the present conditions, the approximate output of factory-sugar is believed to be nearly 11 lac tons per annum and that from *gur* refineries and *khandsaris* to another 1·5 lac tons. During the last three or four years, the production of factory-sugar has come down to about 9 to 10 lac tons only. This drop is perhaps due to some reduction in sugar acreage, brought about by the diversion of some land from cane cultivation, due to the 'grow more food' campaign and to transport and other difficulties, whereby the full crush of the season has not been possible. An idea regarding the annual production of sugar and the number of sugar factories operating in the various provinces of India might be formed from the figures given below, which pertain to the year 1945-46 :

	United Provinces	Bihar	Bombay	Madras	Bengal and Assam	Punjab, Sind and N.W.F.P.	Orissa	Indian States
Quantity of sugar produced in tons	515,900	176,600	72,400	49,200	22,600	10,400	2,100	95,600
Number of sugar factories ..	67	29	10	11	7	3	1	17

In order to achieve the target figure for sugar production to anything between 16·5 to 18·5 lac tons per year, as aimed at by the Government of India, it will be necessary to exploit more fully the crushing capacity of existing factories, to enlarge the existing small factories to more economic and efficient units, to erect new factories and to increase the normal length of the crushing season to 110-130 days in a year, by better organization of planting varieties with different periods of maturity and harvesting and also by providing better supplies of the raw material to the factory. Every effort will, therefore, have to be made to increase sugar production by a steady process of all round expansion, i.e. by the increase of cane acreage, by improving the quality and quantity of cane produced, by providing sufficiently remunerative cane prices to the grower, and by the expansion of factories together with increased supply facilities by better methods of distribution and the reduction in the present high cost of sugar. These are factors which can only be attempted on a fairly long-term basis by proper central control and effective coordination to stabilize both production and distribution in order to meet the growing needs of the country. If the industry is able to seize the opportunity now offered, it might in future be able to acquire for itself a permanent and enduring place in the post-war world sugar industry. The Indian sugar industry today has nevertheless become the second-largest national industry of the country, which represents investment of capital to the extent of about Rs. 33 crores. The industry provides employment to nearly 3,500 University graduates and to 1,20,000 skilled and unskilled workers and it directly interests not less than 20 million cultivators.

The manufacturing efficiency of modern sugar factories in India has improved steadily and has helped considerably in raising the production target, but a great deal of thought, planning and research both from the agronomic as well as the breeding points of view, appear to be essential for securing larger yields of good quality cane per acre. The production of the maximum quantum of quality cane, with a high sucrose percentage, appears to be the main factor for maximizing the production of sugar and lowering its cost of production. The cost of the raw material itself forms more than 60 per cent of the total cost of manufacture of sugar and hence the future advancement of the industry and economy in the cost of production of sugar must necessarily depend upon the proper development of the cane itself.

Prices

In 1937 the Indian Tariff Board estimated the cost of production of white sugar in India, taking into consideration a factory crushing 500 tons of cane per day and working for 150 days in a season, with a recovery of 9·5 per cent, as an economic unit. The capital cost of such a factory was assumed by the Board to be Rs. 16 lacs, consisting of Rs. 12·25 lacs on machinery and Rs. 3·75 lacs on buildings. Profit was reckoned at 10 per cent on Rs. 16 lacs and depreciation at 5 per cent on Rs. 12·75 lacs and at 2·5 per cent on Rs. 3·75 lacs. The interest on working capital for half the season was taken at 5 per cent and the price of cane delivered at the factory at 5½ annas per maund. Accordingly, the cost of production of sugar then amounted to Rs. 6-13-10 per maund, to which the Board allowed another nine annas per maund as freightage from factory to the consuming centres. The Board, therefore, considered that a fair selling price of Indian sugar at that time would be Rs. 7-11-10 per maund. In 1939, the Government of India lowered the import duty on sugar to Rs. 9-12-0 per cwt. With the imposition of a sur-charge of 20 per cent in 1942, the total import duty was raised to Rs. 11-11$\frac{1}{5}$ which rate is still in force. Since then, the price of Indian sugar has rapidly increased under war conditions and due to the steady rise in the cost of capital and other goods, labour charges, cane prices, etc.

Though the War has ended, its after-effect has not ceased to operate and is even worse now. The ex-factory prices of sugar of average quality have, therefore, increased considerably as shown hereunder and the present controlled rate of Rs. 20-14-0 represents an increase of nearly 110 per cent over the pre-war price of Rs. 9-10 per maund :

Year	Selling price of sugar per maund
1942–43	Rs. 11-11-0 at the commencement of the season and enhanced to Rs. 14 on 1-1-43 for the rest of the season.
1943–44	Rs. 14-13-0 with effect from 10-11-43.
1944–45	Rs. 16-4-0 with effect from 21-10-44.
1945–46	No increase up to 5-3-46, but Rs. 16-10-0 thereafter.
1946–47	Rs. 20-14-0 with effect from 23-10-46.

The cane price which largely influences the cost of production of sugar also registered a considerable increase during this period, in sympathy with the prevailing prices of foodgrains and other essential commodities and the Governments of the United Provinces and Bihar fixed the undermentioned minimum prices of cane per maund during the period 1942-43 to 1946-47 :

	1942-43	1943-44	1944-45	1945-46	1946-47
	Annas	Annas	Annas	Annas	Rs.as.
United Provinces	8 upto 30-12-42 10 thereafter	12	14	14½ at gate and 14 outstation	1–4
Bihar	”	12	14 and 15 from 16-12-44		1–4

The price of cane offered in 1946-47 is still considered to be unremunerative for the growers and therefore, the two Provincial Governments concerned, in consultation with the Central Government, are busy now in fixing adequate prices for cane for the ensuing season. The total annual value of sugar and *gur* produced in India is generally estimated at about Rs. 100 crores, and if the developments, now contemplated in the country fructify, it is hoped that India will ultimately become a significant factor in the world sugar market.

Decontrol of sugar

Only a few days ago the Government of India have decided to decontrol sugar. This decision will be welcomed both by the industry as well as the consumers. It is possible, however, that this would cause some temporary rise in sugar prices, but with the prospects of better production in the ensuing season and with more equitable distribution through normal trade channels, the prices would undoubtedly stabilize at a lower level than what was being actually paid during the period of control and hence we must not be overawed by the increase of price we might have to pay in the beginning.

Subsidiary industries

The reduction in the manufacturing cost of sugar could also be achieved by profitable utilization of the bye-products of the industry, such as molasses, bagasse, press-mud, etc. Efforts are, therefore, being made by the Central and certain Provincial Governments to prolong the period of activity and to increase the usefulness and profits of the sugar industry by assisting them in installing industries auxiliary to sugar. The production of power alcohol, rectified spirit, sugarcandy, confectionery, food-yeasts, bagasse-board making, better utilization of bagasse and molasses, etc. are matters which have been and are still receiving due attention.

Sugarcane acreage and sugarcane improvement

The total area under cane in India increased from 2·9 million acres in 1931-32 to 4·6 million acres in 1936-37. During the period 1937-38 to 1944-45 cane acreage varied from 3·3 to 4·7 million acres, depending mostly on the prices of cane and *gur*, in relation to those of other food crops. This acreage represents only 2 per cent of the total cultivated area in India and is approximately equal to 35 per cent of the world's sugarcane area. After 1944-45 there has been a reduction of about 10 per cent in the all-India acreage under cane, mostly due to the diversion of land from cane to food crops and the most attractive prices of the latter. In 1945-46 this acreage was about 3·8 million acres only. It might be pointed out here that even now the sugar factories in India are able to crush only a fraction, i.e. less than about 20 per cent of the total cane produced in the country, the remaining 80 per cent of the cane is being utilized for the manufacture of *gur* and for other indigenous products. Cultivation of cane of the proper type in India falls short of the demand at the present time and hence the extension of the area and intensive cultivation under good quality cane are very desirable.

Improved varieties of cane

In the development of the sugar industry in India, a very important role has been played by the substitution of the indigenous low-yielding and poor sugar-producing types of cane by improved strains of the crop, bred mostly at the Indian Sugarcane Breeding Station at Coimbatore. The achievements of Barber, Venkatraman and others of that Station in this respect will always remain outstanding features in the history of sugarcane-breeding in India. The acreage under the improved varieties evolved at Coimbatore has increased from 11·68 thousand acres in 1931-32 to 36·04 thousand acres in 1944-45 and is still progressing. This constant increase in the distribution of improved varieties of cane explodes the common belief that the Indian ryot is usually very conservative by nature and does not appreciate improvements brought about by the Department of Agriculturre for increasing crop production. The replacement of the indigenous and poor-yielding varieties by improved Coimbatore canes, in a large proportion of the cane area in this country, is ample proof of the keenness and the desire of the ryot to take up very readily seeds and improved methods of cultivation, whenever he has been convinced of their effectiveness. Side by side, the so-called conservative capitalists in India must also be congratulated that they have not hesitated in realizing the importance of sugarcane development and for mobilizing all their resources for developing this industry.

It has very often been pointed out that the Indian sugar industry is weak mainly in its agricultural sphere and that attempts should, therefore, be made to improve the overall average in this respect. The average yield of cane per acre in this country has remained stationary between 15 to 15·6 tons per acre during the last decade, against 50 to 60 tons per acre in Java, although in several areas, such as Mysore and parts of the Bombay Presidency, yields of 50 to 60 tons per acre have been obtained. Given adequate manures, improved varieties of cane, better facilities for irrigation and better cultural practices, there is no reason why our average yields cannot be pushed up very significantly. It is now for the cane breeders, the cane agronomists and the sugar technologists, respectively, to put in their best for increasing cane production and thus raising effectively the sugar production in India to make the country self-sufficient with regard to its sugar supply.

Sugarcane research and the Indian Central Sugarcane Committee

About 28 years ago, the Government of India appointed an Indian Sugar Committee to examine the problem connected with the development of the sugar industry in all its bearings and to advise whether a definite and co-ordinated policy could be laid down for the promotion of further development. The Indian Sugarcane Breeding Station at Coimbatore, the Sugarcane Research Stations at Shahjahanpur, Pusa and Padegaon, as well as the other Provincial centres have catered well on the agricultural side. The Indian Institute of Sugar Technology, Kanpur, has, on the other hand, provided the much-needed technological help and numerous well-trained technicians to the sugar industry. The work of these Research Stations and of the Sugar Technological Institute was previously supervised by the Central or Provincial Governments and by the Indian Council of Agricultural Research, but most of these Institutions have now come under the control and supervision of the Indian Central Sugarcane Committee. This Committee was established in November, 1944, with a view to undertake the improvement and development of the growing, marketing and manufacture of sugarcane and its products, as well as to initiate agricultural, technological and economic research on sugarcane. This Committee is an autonomous body, financed by the Government of India from the Sugar Excise Fund, and is managed by a large number of responsible members, representing all interests connected with the sugarcane crop and its products. The Vice-Chairman of the Indian Council of Agricultural Research, is the ex-officio President of this Committee and the Chairman of this meeting, Sir Shankar Lall is its Vice-President. With the help, advice and cooperation of the best brains in the industry, as well as of experts in the Central and Provincial Departments of Agriculture, the Indian Central Sugarcane Committee hopes to pave the way successfully for a significant amelioration of the sugar industry in India.

The Indian Central Sugarcane Committee has recently acquired a large farm at Lucknow for the purpose of establishing the premier Central Sugarcane Research Institute along with the Institute of Sugar Technology, where all problems of sugarcane research and sugar technology will be investigated side by side. The Committee also proposes, in the near future, to take over the complete charge of the Sugarcane Breeding Station at Coimbatore and it is visualized that all aspects of sugarcane-breeding, sugarcane agronomy and sugar technology would be thoroughly examined under one organization and that useful recommendations could then be made for the development of this national industry in the Dominion of India. The Committee also proposes to start in the near future schemes of sugarcane development and to spend a sum of Rs. 75 lacs during the next five years in order to increase production through proper manuring, adequate irrigation, suitable rotations and by recommending other necessary agricultural methods, based on results achieved by actual experimentation and trials. It is believed that through proper researches and development only India's deficiency in sugar could be made good.

Effects of partition

The partition of India into the Dominions of India and Pakistan since 15 August, 1947, has raised a few new problems for the Indian Dominion. Based on the figures for 1945-46, it will be seen that only 2·46 per cent of the total sugar is produced in the Pakistan area, 10·12 per cent in the Indian States and the remaining 87·42 per cent in the rest of India. Similarly, the number of factories operating in these three areas are 8, 17 and 120 respectively, as is shown below :

Area under	Production of sugar in tons	Percentage of sugar produced	Number of factories in operation
Pakistan Dominion	23,279	2·46	8
Indian States ..	95,600	10·12	17
Rest of India ..	8,25,921	87·42	120
Total ..	9,44,800	100·00	145

As far as sugar production is concerned, the Dominion of India is not likely to be affected adversely by the partition of the country, but it is not yet known whether the Pakistan Government would continue to take the sugar produced in India or would like to import foreign sugar. Every effort will have to be made, however, to see that the position and status achieved by the Indian sugar industry, during the last 16 years, are not only maintained, but also significantly improved, so as to place the Dominion of India in its proper place in the comity of nations as far as sugar production is concerned.

AGRICULTURAL CENSUS

A representative of the F.A.O. will shortly visit India to discuss with the Ministry of Agriculture the preliminary programme of the 1950 World Census of Agriculture, to which the Government of India have agreed to extend their co-operation. The proposals envisage a direct enumeration of individual holdings and supplying accurate and comparable information relating to the statistics of land utilization, area, yield of crops, the number, size of holdings and their tenures, the number and characteristics of the farm population and the statistics of livestocks, fisheries and forestry.—*Food Bulletin*, December 15, 1947.

FINE WOOLLED SHEEP IN NILGIRIS

By S. S. KHOT and K. N. RAMCHANDRAN

NILGIRI—the Blue mountain of South India—is not only famous for its tea, coffee and potatoes, but is also the home of a few thousand of the finest woolled sheep of the Deccan plateau. The origin of these flocks dates as far back as 1837, when projects for sheep improvement and for development of the wool industry were launched simultaneously by pioneers who were officials of the East India Company in the Bombay, Deccan, Mysore and Nilgiris. The only authentic records of these early efforts are available in Thomas Southey's book entitled *Rise, Progress and Present State of Colonial Wools*, published in 1848. In dealing with the subject of the capabilities of India for the growth of sheep's wool, he states 'that the immense range of sheep pasture known to exist *in this highly favoured portion of the globe*, the possession of flocks by several of the native tribes, and the increasing importations of wool into Great Britain from the Presidency of Bombay, aroused in the public mind a new and lively interest, which naturally led to the inquiry of what could and might hereafter be made of this new commodity'.

This interest among the British people in developing Indian pastoral areas for wool production led to the launching of projects in sheep farming in different parts of India. The Saxon, Cape Merino and South Down were the main breeds of exotic sheep used in this effort. The Cape Merino sheep were given preference in large scale cross-breeding as this breed was supposed to be far superior and better adapted to our country. The advent of the foreign breed in the Nilgiris is referred to in one of the letters quoted by Southey in his memoir mentioned above. This interesting letter was addressed by one Colonel Hazlewood to Captain Jacob of the Bombay artillery, dated Bangalore, April 1837, and is reproduced below as it gives in brief the impressions carried by these pioneers regarding the breeding of sheep for the production of fine wool in India :

'I am happy to see that your Government have taken up my plan for improving the Indian wool. I have just received six more Saxon rams from the Raby flock at Sydney ; the price there is ten, seven, and five guineas each, according to the cross, or rather, according to the size. Mr. Sullivan brought out two merino rams and two ewes, and I have seen the effect of crossing by these, and also by South Down rams imported by Sir William Rumbold on the Nilgiris. Even the red hairy sheep of India become South Down in size and wool in the second generation ; and the white woolly sheep of India become Merino, and South Down in size and wool, after crossing. I have shorn Mr. Sullivan's Merinos, which have been two years in India. After twice washing and shearing the day after, the ewes gave five and four and four and a half pounds each ; in fineness, length of staple, elasticity, and oiliness equal to any I ever saw in Tasmania, where two and a half pounds is the utmost ever got from a ewe of the Merino kind, which seldom weigh more than fifty pounds per carcass when killed ; and these ewes of Mr. Sullivan's had been shorn only seven months before.

'My flock I have removed here (Bangalore) from the hills (Neelgheris), as the rank grass there does not answer for sheep brought from below, although those bred there thrive exceedingly well. I am completing my flock here to 700 white woolly ewes, for which I have rams enough, pure Saxon. The rutting season begins here in June, and the lambing from November to January and they may be shorn in February and in September. I do not know if you have any white woolly ewes, indigenous to your provinces, although I know you have the black woolly ; but you may get the white ones between Jalna and Beder, where I hear there are many flocks. We only have them in Coimbatore, and the Barramahal. After my flocks have given their first lambs, I shall turn them over to the Mysore Commissioner, and return to Tasmania'.

Present condition

The existence of the fine woolled flocks in the Nilgiris received little attention till

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September, 1945 when the Government of Madras deputed two persons for training at the Wool Analysis Laboratory, sponsored by the Indian Council of Agricultural Research, Poona. Samples of wool were brought by them from all the sheep rearing districts of that Province to the Laboratory. While analyzing these samples, it was observed that some sheep in the Nilgiris, in the vicinity of Ootacamund, yielded the finest fleeces, as compared with the wool received from other parts of India. With the object of ascertaining whether advantage could be taken of the Nilgiri breed for the improvement of sheep in this Province, the Government of Bombay deputed one of us (SSK), to study the conditions in which these sheep are reared at present. The following paragraph gives a brief account of the observations and enquiries made.

Sheep grazing area

The heights of the Nilgiri plateau vary from 3500 to 8000 feet above sea level. The rainfall ranges from 30 to 300 inches in the Nilgiris district and in the area where the fine woolled flocks are raised the extent of rainfall varies from 50 to 60 inches, and is distributed almost throughout the year maintaining green pastures except in winter. The extent of rainfall on the plateau where the flocks are located gets the benefit of both the monsoons. In the Wynaad, which receives the full blast of both the monsoons, the rainfall is as high as 300 inches a year. The sheep are not bred in this heavy rainfall tract. The rolling hills beyond Coonoor, towards Ootacamund and the Wenlack Downs, constitute the grazing area for sheep.

The plateau has a temperate climate and the maximum temperature of the day vary from 62° to 80°F. and the winter temperatures during the nights range from 45° to 54°F. On the western half of the plateau frosts are common during winter, when very little grazing is available both for sheep and cattle. The flocks at this time have to take recourse to the vestiges of grasses protected under tree groves or in the '*sholas*' (a term used in this area for stunted evergreen patches of scrub jungle which grows in the hollows or folds of slopes). The whole of the plateau is a vast rolling grass land interspersed with wooded '*sholas*'. The rank grasses mentioned in the letter quoted above are to be found in the heavy rainfall tract of the western side of the plateau. The principal grasses in places where sheep graze are *Andropogan pertruses, Ischacmum pilosum, Thaemada inberbis and Androprogan pumulus.* The pastures have no legumes at all but small herbs of the *compositae,* the sun flower order, grow abundantly on the Downs. The herbs of the *Euphotorium* species, which can withstand frosts to a great extent during winter, are liked by sheep. Except in the heavy rainfall area, the sward does not grow to a height more than six inches and hay making from the existing grazing areas is almost an impossibility. The grass in general on the Downs grows to a height liked by sheep. The South African Kikiyu grass has come to stay in the vicinity of Ootacamund to such an extent as to exclude every species of grass. The plateau abounds in small innumerable picturesque streamlets and there is no dearth of water supply. There is an old custom of the burning of the grasses by the Todas every year sometimes at the end of February and, it is believed, that this annual burning helps in the desired growth of grasses and also in preventing diseases. The Forest Department is trying to curb and regularize the practice of burning of prairies as the development of forestry is greatly hampered by this ancient system followed by these cattle breeders.

Sheep and wool

The sheep are allowed grazing in the forset area on permits and a population of about 30,000 sheep is recorded by the Forest Department for the year 1942, for the Nilgiri division. The fine woolled flocks are only present on or around the Wenlock Downs. These are owned by Badagas, who were once classed as aboriginal tribes. In this area the Badagas community forms generally the cultivating class and owns cattle, and the Todas, an ancient race of this district, are the rearers of buffaloes. The strength of a flock owned by a Badaga varies from 40 to 50 sheep. Enquiries among the flock owners elicited no information regarding the origin of these sheep. Some of the old planters corroborated the information noted in the above given letter that Mr. Sullivan was responsible for the introduction of sheep from abroad and that he also maintained Jersey and Ayrshire cattle which have given rise to the present-day Nilgiris 'cow'. Mr. Sullivan is credited with having maintained a cross-bred flock of Merino, while Sir William Rumbold had imported South Down sheep. The

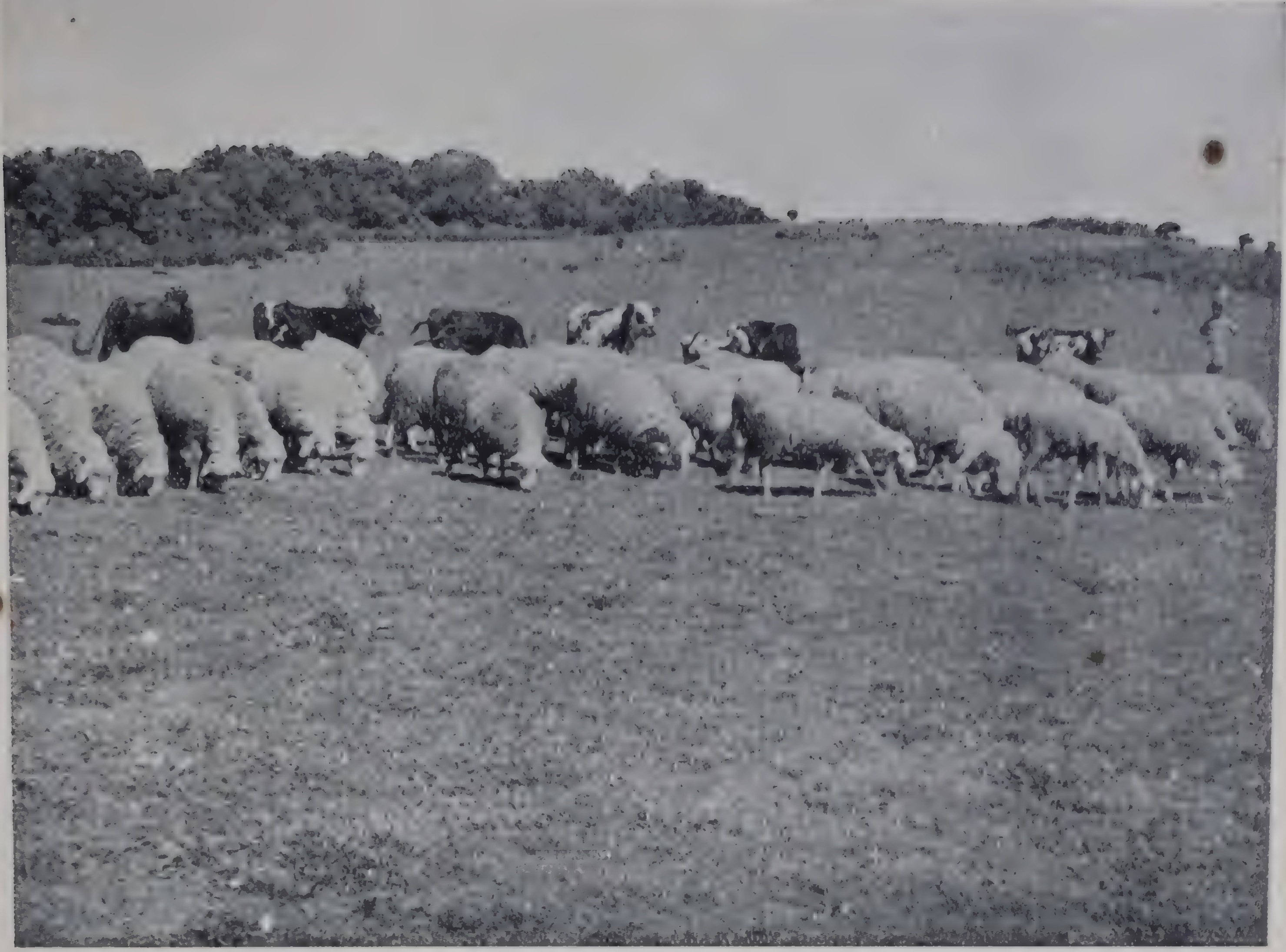

FIG. 1. Flock of Nilgiris sheep

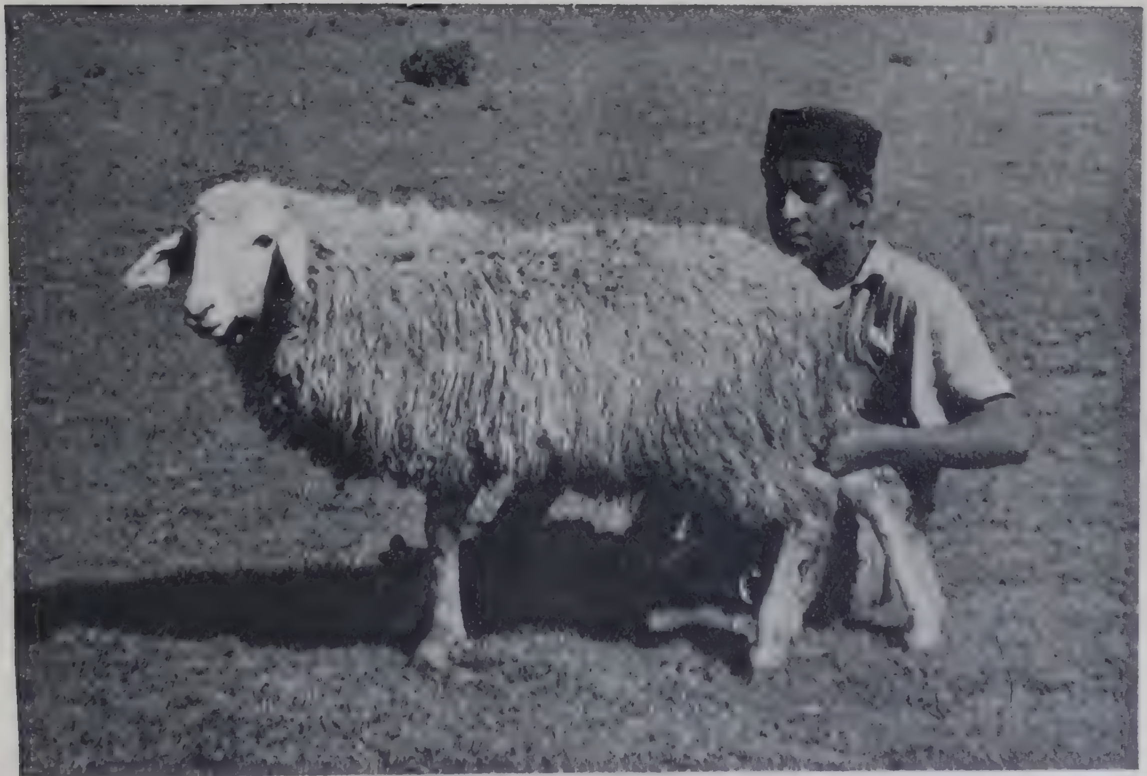

FIG. 2. Nilgiris ram

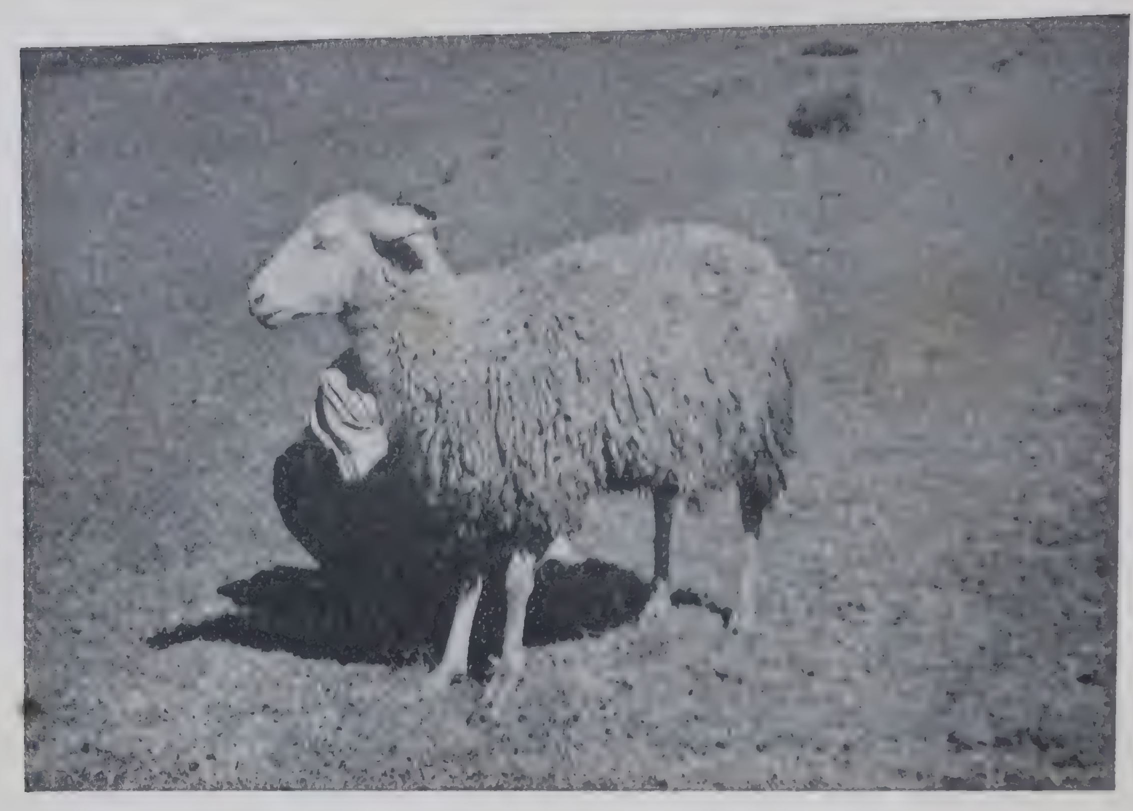

FIG. 3. Nilgiri ewe

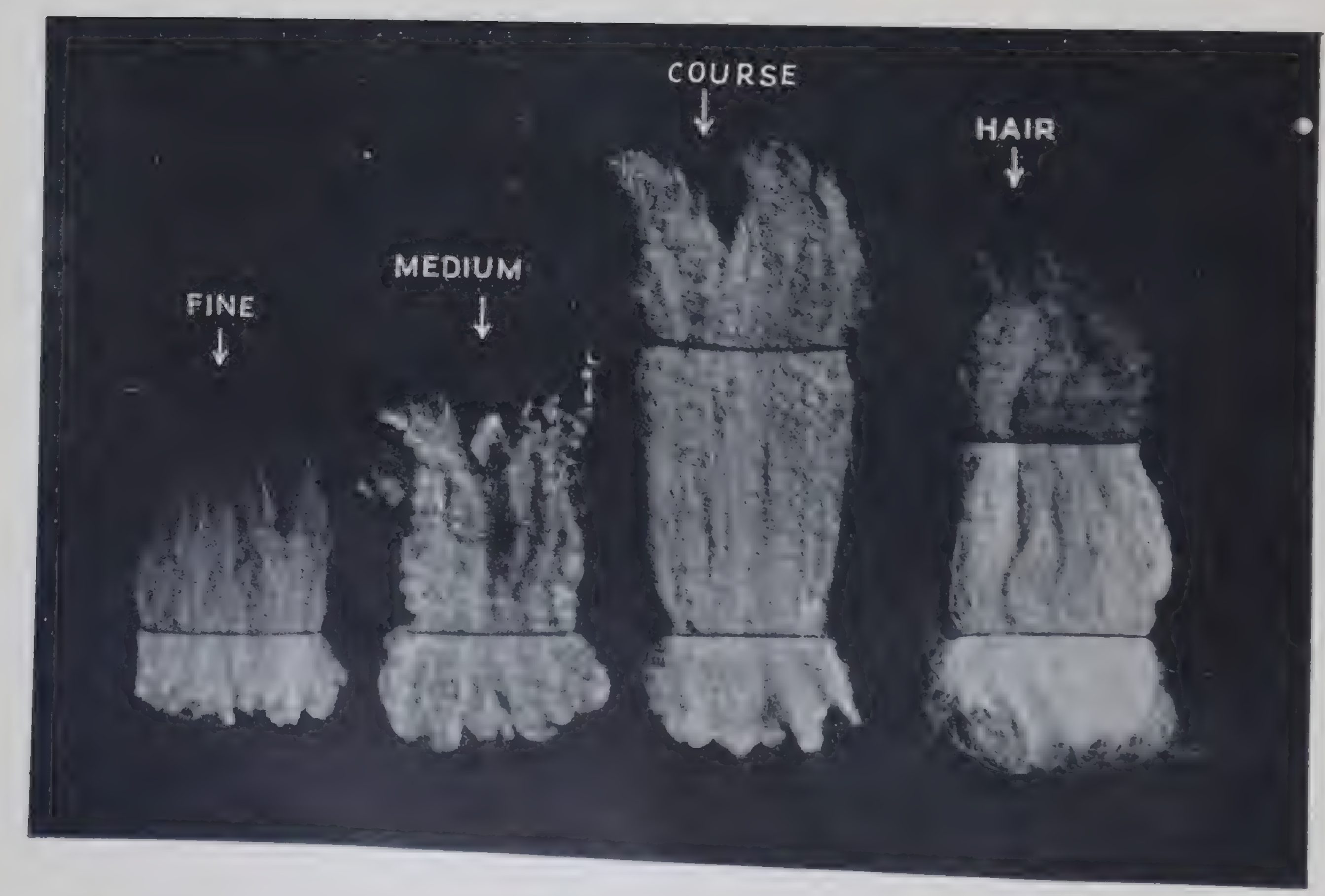
FINE
MEDIUM
COURSE
HAIR

FIG. 4. Wool types

PLATE 3

interbreeding of these breeds with the red hairy sheep from Coimbatore district has resulted in the present-day fine-woolled flocks. The woolly character inherited from the exotic breeds was retained among these flocks because the pure hairy sheep cannot survive in the cold and moist atmosphere of the hills. During the recent war, due to the great demand for mutton, the flock owners imported the hairy sheep from Mysore and Coimbatore. Although these sheep have not survived, a certain amount of cross breeding has taken place and the quality of wool has deteriorated in a few flocks. The Veterinary Department also introduced a few Bikaneri rams. Fortunately, these sheep died without leaving any progeny, except in one flock where the resultant progeny is growing long, coarse wool, with a canary colour which depreciates the value of wool.

These Nilgiris sheep are small in size; the weights vary from 55 lb. to 75 lb. in ewes and 80 to 90 lb. in rams. The majority of them are white sheep, but a few have a light roan colour in their faces. The nose is straight and the occipital bone is prominent, giving the forehead a flat appearance. The eyes are generally light brown but in almost all the sheep the skin of the eyelids has a dark brown ring. The hoofs are white but the sheep which have dark brown or a brown colour on the face, have also a corresponding brown tint on the hoof. The shanks in these sheep have brown hair. The sheep are hornless but small scurs are occasionally seen. The face is covered with short, rough, chalky hair and is free from wool. The height at the point of shoulder varies from 16 in. to 18 in. and the length from the point of shoulder to the pin bone is 24 in. to 26 in. and the girth varies from 27 in. to 32 in. The length of the ears varies from 3½ in. to 4 in. and they are held sideways like the 'Down sheep. These sheep still retain the long tail of the exotic breeds, length ranging from 5½ in. to 7 in. as compared with the 2 to 3 in. long tail of the hairy sheep from the plains.

In general, the best of the fleeces can be classed as Romney wool of a good quality except for the hairiness in certain animals. The fibres have regular crimps and have a uniform diameter varying from 25 to 28 microns, and, in the coarser type of wool, the diameter range is from 30 to 34 microns (1 micron is equal to 1/1000 of a millimeter or 1/2500 of an inch). A number of samples was analyzed and it was found that about 50 per cent of fleeces had uniform wool quality with little hairiness and the rest possessed varying degrees of hairiness. The sheep carrying good and bad quality wool exist in the same flock as there has been no selective breeding carried out by the flock owners. It is rather difficult to give the exact figures for the staple length as no regular shearing is undertaken. At present the livestock department is persuading the shepherds to shear their sheep. In the flocks which were shorn the wool has grown 5 to 6 inches in length in a year. Those sheep which have never been shorn carry broken fleeces and the staple length varies from 5 in. to 16 in. The fleece is of an open character and parts off the back. This characteristic of the open wool of the fleeces is a great asset, as the sheep can 'ring out' the water. Except for the shanks and the face, the whole of the body is covered with wool. The exposed portion of fibres are severely damaged. When the wool is carefully washed, the damaged portion of the fibre still retains the stains of excreta and has little tensile strength. The fleeces are free from burrs, particularly of the obnoxious type like the needle burr, (seed of *Andropogan contortus*) and the species of *Triumfetta*, *Aristida* and *Zarnia* which are a great hindrance to the development of fine wool on the plains. The quality of wool in general can be classed as 48s' to 50s' combing and can be used for making high class tweeds or soft hosiery. It is difficult to make an accurate estimate of the wool yield because the sheep are not regularly shorn, but a rough guess is that the wool yield would come to 2½ lb. per clip. The flocks are penned at night in low roofed small rooms with little ventilation. The floor is not paved and the dung and urine accumulated in the pot holes give these sheds an appearance of a dirty pig hovel rather than a sheep pen. Leaves and twigs are strewn on the floor to absorb the excreta and, if not for the cold climate, a flock of sheep would not survive for any length of time. Panthers cause a great deal of trouble and the shepherd is forced to pen the sheep in these conditions. Well-drained and properly ventilated sheep houses could be made but it would be necessary to help and educate these shepherds in the construction of healthy sheds. At Wellington the golf club maintains a small flock of sheep on the links and a properly ventilated cheap sheep house has been constructed on its estates. This may be copied with advantage by the flock owners on the Downs.

Future plan

As stated above, Ootacamund area receives rain throughout the year, except in winter, and a shepherd from the plains would never believe that this sheep would survive such wet and miry conditions. The present flocks have adapted themselves to the rigours of the monsoon after a century of breeding by natural selection. There is plenty of milk in ewes and, considering the method of management and grazing, the lambing percentage is also satisfactory. There are two lambing seasons, one in September and the other in March. The flock owners were not able to give any definite information regarding the best time for lambing, shearing and on matters connected with management. They are still ignorant of the importance of the wool produced by their flocks and in the majority of cases the clip is wasted. The problems of sheep husbandry will have to be studied carefully. The material for experimental breeding now available is excellent. The liver fluke and the blue bottle fly are almost absent in this area. Nor is there the trouble of the nodular worm which is a bane to sheep farming on the plains. In introducing a new species of sheep or even in selective breeding, attention will have to be given to evolving a type which can stand wet feet for, inspite of the acclimatization of these flocks for a century on this plateau to severe rainfall conditions, the sheep occasionally suffer from foot rot, which is probably an outcome of continuous walking on watery pastures.

There are great possibilities of developing these hills into a pastoral country for the production of fine wool, but this work will have to be linked with agricultural development and handled by a specialized staff. The climate and edaphic conditions of the Nilgiris are altogther different from those existing on the plains and the problem of raising fodder and root crops for sustaining the sheep during winter would require special attention. There is little calcium in the soils and the shifting cutivation by the Badagas has exposed large areas to erosion. These hills constitute the most sparingly populated district in Madras province and the colonization of the vast grass lands will have to be undertaken under a coordinated plan for agri-pastoral development. A great deal of spade work has been done by the Agricultural Department in systematizing the growing of vegetable crops and the Nanjanad Farm is experimenting on the problem of raising food grains. Turnips and carrots, which can be used as supplementary food for sheep, thrive well on these hills but the raising of legumes in the fields and pastures would form a problem by itself. Of the lupins, the *angustofolius* species thrives well in these climatic conditions. However, given the fundamental background of a planned mixed farming system, the plateau would form a fine wool-producing country and the future programme of the development of sheep industry would envisage :

(1) research in selective breeding among the existing sheep to obtain uniformity in wool quality and to eliminate the hairiness ;

(2) trials with exotic breeds of sheep, such as the Romney Marsh from New Zealand ;

(3) the study of problems of sheep husbandry, including that of management of grasslands, raising of sheep fodders, protection of sheep during winter, etc. ;

(4) projects for encouraging flock owners to undertake breeding for fine wool production, and

(5) finally, the utilization of the classed wools in the rural industry.

Acknowledgement

The authors are indebted to Mr. P. R. Yeri, for carrying out detailed analysis of the Nilgiris wool.

The officers of the Agricultural and Forest Department at Nilgiris were also helpful in explaining the agrostological conditions.

PRESERVATION OF WATER MELON JUICE

By GIRDHARI LAL and NAGINA LAL JAIN

WATER melon (*Citrullus vulgaris*) is very widely cultivated in almost all parts of India and is available in the Punjab markets in the months of June, July, October and November. During these months, the fruit is so abundant that fruits of the best quality sell at Rs. 3 to Rs. 4 per maund. The pulp of the fruit which has usually an attractive red colour is very palatable and refreshing.

Some work on the preparation and preservation of water melon syrup has already been reported by G. S. Siddappa*.

In response to an enquiry from the Indian Council of Agricultural Research, the possibilities of utilizing this fruit for making some suitable beverages were investigated. The results of the investigation are briefly described in this paper.

Analysis of fruit

The fruit is of a fairly big size and is sufficiently rich in juice content. The juice contents of five different lots of melons are given in Table I. The yield of juice varied from about 35·5 to 47·6 per cent with total soluble solids varying from 5·7 to 7·5 per cent.

TABLE I

Analysis of water melon fruit

Date	No. of fruits	Weight of fruit (lb.)	Weight of juice (lb.)	Weight of rind (lb).	Weight of seeds & pomace (lb.)	Percentage of juice on whole fruit	Total soluble solids (Brix degrees at 68°F.) in juice
29.6.43	–	82·00	39·00	32·00	11·00	47·56	7·50
2.7.43	6	53·50	19·00	27·00	7·50	35·51	7·25
19.7.43	9	62·50	28·00	22·00	12·50	44·80	5·70
21.7.43	8	104·00	47·00	37·00	20·00	45·20	6·70
8.7.44	2	44·00	19·00	18·50	6·00	44·32	5·80

Juice extraction

The juice was extracted by pressing the cold pulp, which was scraped from the rinds with a sharp knife, in a small basket press†. Heating of the pulp for five minutes at 140°F., prior to pressing, did not yield a product in any way superior to the cold-pressed juice; on the other hand, it caused a slight adverse change in colour.

Experiments on preservation of juice

The juice was preserved in different forms, viz. as pure juice, with and without added acid, as sweetened juice and as squash, with different sugar concentrations and appropriate acidities. The flow-sheet given as under indicates the details of the experiments.

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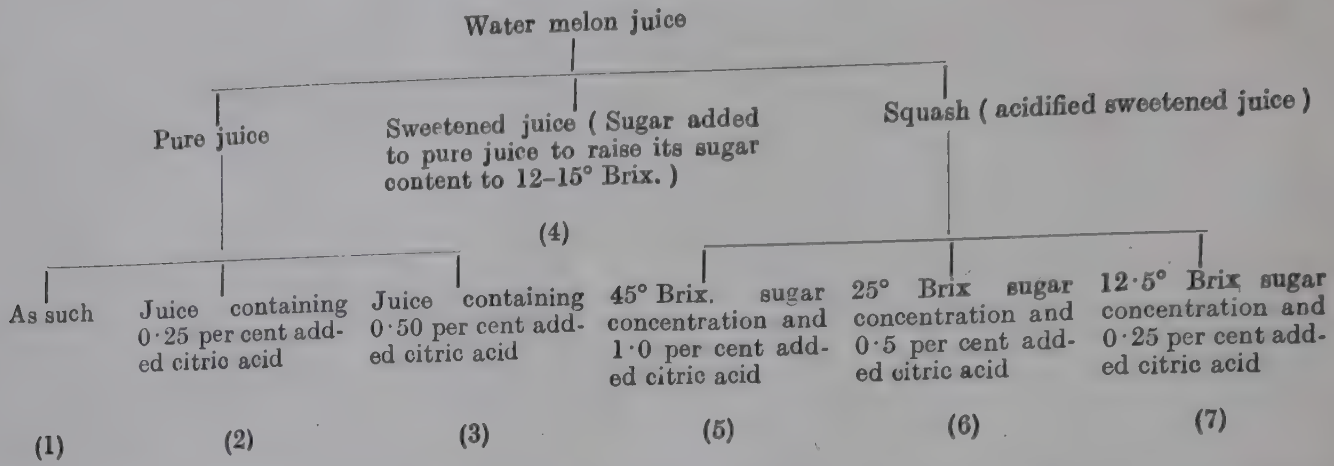
* Annual Reports of the Fruit Preservation and Canning Station, Quetta, for the years 1941–43.

† Lal Singh and others, *Indian Farming*, Vol. IV, Feb., 1943.

GIRDHARI LAL, PH.D. (Lond.), D.I.C., is Director and NAGINA LAL JAIN, M. SC. (Tech.), is Assistant Biochemist, Indian Institute of Fruit Technology, Lyallpur.


Water melon juice
Pure juice
Sweetened juice (Sugar added to pure juice to raise its sugar content to 12–15° Brix.)
Squash (acidified sweetened juice)
(4)
As such
Juice containing 0·25 per cent added citric acid
Juice containing 0·50 per cent added citric acid
45° Brix. sugar concentration and 1·0 per cent added citric acid
25° Brix sugar concentration and 0·5 per cent added citric acid
12·5° Brix sugar concentration and 0·25 per cent added citric acid
(1)
(2)
(3)
(5)
(6)
(7)

The methods employed in general, for the preservation of the juice in different forms, were as follows :

(i) Pasteurization in the bottles (6 oz. capacity) for 20 minutes at 175°F.

(ii) Pasteurization in the bottles (6 oz. capacity) for 20 minutes at 190°F.

(iii) Pasteurization in the bottles (6 oz. capacity) for 20 minutes at 240°F. (in a pressure cooker).

(iv) Addition of sodium benzoate at the rate of 1000 parts per million.

(v) Addition of sulphur dioxide at the rate of 350 parts per million.

(vi) Addition of sulphur dioxide at the rate of 350 parts per million in combination with sodium benzoate at the rate of 500 parts per million.

(vii) Addition of sulphur dioxide at the rate of 200 parts per million in combination with sodium benzoate at the rate of 1000 parts per million.

Forty sets of juice and squash, as prepared under the above experimental scheme, were stored. The various sets were examined immediately after packing and subsequently four times during a storage period of about 1½ years.

Discussion of results

'Cut-out' examination of all the sets examined during storage (as mentioned above) revealed that pure juice (No. 1 in flow-sheet) could be preserved only by sterilization at 240°F. and by none of the other methods tried. With the addition of citric acid (0·25 to 0·50 per cent), however, it could be preserved by all the methods of preservation. But, the taste and flavour of the samples of pure as well as acidified juice, preserved as above, irrespective of the method of preservation, greatly deteriorated immediately after packing. It acquired bad disagreeable odour and 'off' taste. The samples preserved with sodium benzoate alone or by pasteurization (at any of the three temperatures), in addition, greatly deteriorated in colour. Sweetened juice (No. 4 in flow-sheet) also could not be preserved satisfactorily. In the form of squash (No. 5 in flow-sheet), with sugar concentration of 45° Brix. and citric acid at 1·0 per cent, however, melon juice could be preserved most satisfactorily, yielding a product with good colour, aroma, taste and flavour, which were very well retained during the entire storage period. It yielded a pleasant and refreshing beverage when diluted four times with water. Samples containing lower sugar concentration, viz. 25° and 12·5° Brix. and appropriate acidities (Nos. 6 and 7_a in the flow-sheet), could also be preserved successfully and had good colour, taste and flavour immediately after packing. They, however, deteriorated rapidly during storage, acquiring a bad disagreeable odour and were 'off' taste within a month's storage. Out of the various preservatives tried for satisfactory preservation of squash, sodium benzoate gave comparatively better results, flavour of the product preserved with this being somewhat superior to that of the samples preserved otherwise.

Conclusions and recommendations

Water melon juice behaves like non-acid vegetable juices and as such does not lend itself to easy preservation. When preserved in pure form, with or without the addition of acid, it is not palatable. As squash of 45° Brix. sugar concentration and with 1·0 per cent acidity, however, it can be preserved most satisfactorily. The method of preparation of this squash is given below.

Extraction of juice: Select fully ripe fruits and cut into halves. Remove the entire pulp (along with seeds) by scraping with knives, and press it in a basket press* to extract the juice which may be strained through muslin cloth. (For large scale production, an hydraulic press and a pulping machine of suitable mesh may be used with advantage).

Preparation of squash: Weigh out the following quantities of juice, sugar and citric acid; mix thoroughly and finally strain through muslin cloth or fine sieve of a non-corrodible metal.

Juice	7·5 lbs.
Sugar	5·25 lb.
Citric acid ..	2 oz.

Preservation of squash: To the prepared squash add sodium benzoate at the rate of 1 lb. per 1000 lb. (sodium benzoate should first be dissolved in a little water and then mixed thoroughly in the entire squash). Fill in clean sterilized bottles, seal airtight and store in a cool dry place.

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* Lal Singh and Girdhari Lal (1938) 'Studies in the Preservation of Fruit Juices, 1. Some observations on the preparation and preservation of citrus fruit squashes'. (*Indian J. agric. Sci. VIII, (I)*).

FOOD FROM DUST

MESSAGES wishing success to the compost-making drive of the U.P. Government have been received from Indian leaders.

Mahatma Gandhi says: ' Compost means production of food from dust and saving crores of rupees. Will the Indian kisans learn this magic ? '

' We fought the battle of freedom and achieved it. But *swaraj* cannot be completed unless the difficulties of the people are removed and there is proper arrangement for food, cloth, houses and education for them. We have to fight another battle to remove the poverty of the masses. In this battle we have not to fight against anybody else but to work in a way which would increase production. The number of kisans in this country is the largest in the world and agriculture is our main industry. As in other countries, it is necessary to increase the fertility of the land, to bring prosperity to the peasants and the country,' says Pandit Nehru.—*Food Bulletin*, February 2, 1948.

COST OF MAKING SILAGE

By YASHPAL CHANDRA GUPTA

THE art of preserving the cattle fodder is as old as civilization itself. During the monsoon season, we have all over the country an abundance of green fodder. Naturally the entire quantity is not beneficially utilized and a considerable portion goes to waste. The excess should be preserved during this season of plenty, thereby preventing undue wastage. One of the recognized methods of preservation of fodder is to ensile them whilst it is still green. This is done either in a pit or in a tower and these pits or towers are known as 'silos'.

The other method of preserving fodder is by converting it into suitable hay. Hay making can best be done by cutting the fodder when the crop is still immature but is about to ripen and has started drying partially. The greatest difficulty in converting the fodder into hay is that we may not have sufficient sunshine when the fodder is ready to be preserved or there may occur untimely rain to spoil the quality of hay. Further, it is an inflammable material and at any time there are risks of its catching fire. It also requires greater labour and larger space for stacking hay. In hay-making some of the nutrient materials are lost, particularly protein, while in silage the nutritive value of the fodder is completely retained in the fodder.

Silage making is a pretty old art. For the past fifty years the greatest advance has been made in this direction in the United States of America, Russia, The United Kingdom, Australia, Newzealand, Denmark and other countries where dairying is extensively practised. But it has not caught the imagination of the Indian agriculturist as yet, though this system of preserving green fodder and grass may be advantageous to the poverty-stricken Indian cultivator. A silo may be constructed in a number of ways; towers could be of brick, concrete, stone or even wood. Similarly the silo pits could be plain and simple pits with or without any masonry lining, depending on the soil conditions of the farm and its financial position and the number of cattle to be fed.

Silo-pits are cheaply constructed and require very little attention when once made. They can be filled in easily without the aid of costly machinery and power. Silo-pits should be properly fenced to prevent dairy herd animals from falling in. There is also the danger which must be guarded against, that of carbon-dioxide formation due to seepage in rainy season which may cause rapid deterioration of the stuff.

The silo-pit should always be built on a higher level and possibly where the soil is hard. It should never be built where the water level is high.

Unless properly made the silage does not preserve its fodder value well. Maize, *sorghum*, grasses and legumes can be converted into silage in such a way that their food value is not lost. The grasses such as *dub*, *khabal*, etc. can also be similarly conserved when available in plenty.

Good silage can be made by harvesting green fodder when it is mature without becoming ripe, and when it is still green. If ensiled, when they are too green, the silage will become sour and watery and there will not be the same amount of digestible food as when the fodder is allowed to mature. If too dry, the material will not pack down properly in the silo; consequently all the air will not be driven out, and the stuff will become mouldy. Woody and fibrous materials should not be ensiled for such a feed will not be nourishing or palatable. Very good silage could be made from *sorghum* when the seeds are in the milk stage and the lower leaves have just started turning yellow.

Table I has been compiled from the records of the Agricultural Sub-Station of the Indian Agricultural Research Institute. The silo-pit without any masonry lining is in use here. It is just a rectangular pit, 6 ft. deep, 30 ft. wide and 19 ft. broad.

There is no special machinery to fill in the

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pit. The required quantity of fodder is dumped in and is well pressed down. Each pit is filled in 4 to 6 days; the central portion is raised 6 to 8 ft. high from the ground level with a slope on all sides and then the heap is covered with a layer of mud one foot in thickness. During the rains if any crack occurs on the plaster, it is closed with a thick coating of mud in order to avoid any seepage. Six weeks after the operations are complete, when the necessary fermentation will have taken place, the silage may be taken out and fed to the cattle. Records elsewhere show that in good pits silage can be preserved for nearly 20 years.

TABLE I

Cost of preparing silage in the pit silos at Karnal during 1946

Date of filling	Fodder and Quantity in maunds	Cost of harvesting	Cost of carting	Cost of filling	Cost of covering the pit	Total cost	Unit cost of making 1 maund of silage
		Rs. as. ps.	Rs. as. ps.	Rs. as. ps.	Rs. as. ps.	Rs. as. ps.	as.
8–8–46 to 12–8–46	*Sorghum* 2220	79 3 0	87 6 0	26 8 0	7 8 0	200 9 0	1·45
13–8–46 to 17–8–46	1868	68 0 0	87 15 0	26 0 0	10 1 0	192 9 0	1·65
17–8–46 to 21–8–46	1272	44 6 0	63 4 0	25 9 0	6 4 0	139 2 0	1·75
21–8–46 to 26–8–46	2000	67 2 6	78 8 6	30 1 0	8 7 0	184 3 0	1·47
27–8–46 to 31–8–46	1534	77 4 6	41 14 6	28 8 0	9 0 0	156 11 0	1·63
1–9–46 to 3–9–46	1605	49 10 0	53 2 0	16 12 0	7 8 0	127 0 0	1·24
8–9–46 to 14–9–46	2483	120 14 0	110 6 0	37 5 0	8 6 0	277 0 0	1·79
14–9–46 to 24–9–46	Corn and Cowpeas 3037	156 8 6	155 14 0	43 12 0	7 4 0	362 6 6	1·91
Total	16,019					1,639 8 6	1·64

The data presented in Table I show that on an average the cost of making silage in a pit comes to about two annas per maund after making due deductions for the wastage. It must be noted that about 10 per cent of the material goes to waste, particularly the top layer and some on the sides of the pits.

Cost of making silage per maund ..	1·64 as.
Cost of 10 per cent of the silage waste ..	0·17 as.
Total ..	1·81 as.

roughly as. 0-2-0 per maund.

That is to say roughly the cost would come to about two annas per maund.

TABLE II

Cost of raising juar per maund at Karnal (*Block No.* 7, *area* 44·34 *acres*)

	Rs. as. p.
Cost of preparation of land with tractors ..	121 5 11
Cost of sowing juar ..	195 0 0
Cost of 26 maunds 6 seers of *juar* seed at Rs. 6 per maund ..	156 14 6
Harvesting charges of *juar* fodder	323 5 8
Irrigation charges : labour employed for irrigation ..	53 11 10
Canal irrigation charges ..	217 9 3
Miscellaneous charges ..	42 8 0
Rent of land (if land does not belong to the cultivator) at Rs. 25 per acre ..	1108 8 0
Total ..	2218 15 2

Outturn of green *juar* from 44·34 acres
10,381 maunds 10 seers.

Cost of green *juar* per maund 3 annas 5 pies or roughly 3½ annas per maund.

While calculating the cost of making silage, capital incurred in making silo-pits, depreciation, interest, etc. on the capital should also be taken in the account. Silo-pits are made *kachcha* and should be 30 ft. × 19 ft. × 6 ft. deep. This means digging out 3,460 c.ft. of earth. The rate of the Public Works Department for digging at the present is Rs. 12 per 1,000 c.ft. Total cost of digging the silo-pit thus comes to Rs. 42. The average life of the silo-pit may be taken as 10 years and, on a moderate estimate, the depreciation, interest and repairs, etc. per year will come to Rs. 10. One silo-pit on an average contains 1,800 maunds of green *juar*. The cost thus comes to 1 pie per maund.

	Rs	as.	p.
	per md.		
The cost of raising green *juar* comes to	0	3	6
Cost of making silage comes to ..	0	2	0
Depreciation, interest, repairs on capital	0	0	1
Total ..	0	5	7

Or we may say that the cost works out to six annas per maund.

We get succulent fodder at the rate of six annas per maund ; at this rate it is difficult to procure green fodder in the periods of scarcity. Fodder grasses like *khabal* and *dub* are available more cheaply.

The silage made at the Karnal Farm was from whole *Sorghum* and the fodder were not chaffed before ensiling. When chaffed the wastage in the byre is small as stacks are also eaten up. This requires a little extra labour for ensiling, and to get a large number of workmen during the havesting season is difficult. The silage may however be prepared and fed without chopping ; the cattle seem to relish it.

The silo preserves the fodder in its best form for feeding the cattle and it is a cheap means of conserving fodder. The silo-pit can be most cheaply and conveniently made in all the Indian villages for conserving grasses when they are available in plenty.

SIRE IN U.S.A.—BUT CALVES BORN IN AUSTRALIA

THREE calves have been born in Australia from mothers inseminated with fluid flown from the United States. The sire is Royal Heritage, a top-ranking Jersey bull from Pennsylvania. He is now the father of three perfectly-formed calves in Australia.

Enough fluid to inseminate 18 cows was brought by air to Australia, vacuum packed at a constant temperature of 40 degrees. Seven days after the fluid left U.S., the Australian cows were inseminated.—*Agriculture Newsletter*, Release No. AGR/164.

'PITTO' AND 'GILLAR' IN SHEEP AND GOATS

By P. B. KUPPUSWAMY

A COMMON disease in goats and sheep known as 'Pitto' and 'Gillar' had been known to exist for a long time in different parts of India, specially Bihar. The name 'Gillar', which in Hindusthani signifies something pertaining to throat, is due to almost constant and characteristic oedematous swelling which occurs in the submaxillary space and appears to have originated from the Punjab. The disease in this province is variously known as 'Chherah', 'Tunki', 'Petchalli', 'Gatchalli', 'Haiza', 'Gadar', 'Jobar', 'Lackwa', 'Gokpulli', 'Kach', 'Kurkuria', 'Gilte', 'Gargatti', 'Pukhawa', 'Gegua', 'Phetphanga'. In United Provinces, it is commonly known as 'Bisi'.

Symptoms

The disease is characterized by loss of appetite, mucous diarrhoea, inability to stand due to extreme weakness, thick mucous discharge from the nostrils making breathing difficult, appearance of non-inflammatory swelling at the intermandibular space in most of the cases and absence of fever. The animal dies in a day or two after the onset of diarrhoea. In mild cases, it takes a prolonged course continuing up to 15 days and ultimately resulting in death. Prolapse of the rectum due to severe diarrhoea has been noticed in some cases. The wool of the affected animals peals off easily.

The size of the intermandibular swelling is very small and insignificant in the morning but it gradually increases in size, so much so, that late in the evening it is as big as to extend upwards over the face and posteriorly up to the neck; the swelling again becomes reduced in the morning. This variation in the size of the swelling is probably due to the fact that the animal while grazing during the day hangs its head down and owing to gravity more fluid accumulates at the intermandibular and the surrounding spaces resulting in the increase of the swelling in the evening. Similarly during the night when the animal is at rest and is lying down, the fluid in the swelling gradually recedes resulting in the decrease of the swelling in the following morning.

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The disease, which might be mistaken for rinderpest, can be easily differentiated by the absence of fever and mouth lesions.

Incidence and losses

This disease is responsible for very heavy losses among sheep and goats. But due to the ignorance and indifference of the owners, the disease did not attract any great interest in the past. Further, sheep and goat diseases did not receive much consideration in the past owing to the fact that almost wholesale attention was monopolized by diseases affecting more valuable animals, viz. cattle.

It is widely prevalent sometimes in epizootic form in low-lying water-logged, swampy, and humid areas whereas it is rare or totally absent in uplands, and dry and less humid areas. In the districts of Patna, Shahabad, Muzaffarpur and Champaran, which contain extensive low-lying water-logged tracts, the incidence of the disease is more and the death rate among the ovine population is 30 to 90 per cent, while in Ranchi, Hazaribagh, parts of Santhal Parganas and Palamau, which are dry and upland districts, the incidence is very rare or absent and the death rate is only 0 to 30 per cent.

The disease as a rule is absent in dry uplands, but when there are networks of canals, lakes, ponds and places of stagnant water, the disease does appear even in the dry areas. Similarly, the animals in dry areas which are exposed to floods from the adjoining rivers, also acquire the disease following the floods. However, the death rate in these circumstances is not so high as in the low-lying water-logged tracts.

The regional incidence of the disease is also closely associated with the distribution of snail population.

Susceptibility and mortality

The young as well as adult sheep and goats are equally susceptible to this disease. The cattle, including the buffalo calves, have also been found to suffer from a similar disease. There is no immunity against the disease.

Usually there is no recovery from the disease, but in mild cases, where the disease has taken a prolonged course, some affected animals may recover. The death rate in different parts of the province varies considerably from 0 to 90 per cent in the circumstances as already stated.

Etiology

As a result of investigations and research carried out, it has been established that this disease is not caused by micro-organisms such as bacteria or protozoa or even by virus but is due to worm parasites (immature amphistomes). This has been confirmed by experimental infection of healthy animals with the larval forms (*cercariae*) of the amphistomes.

Mode of infection

The snail (belonging to the species of *Indoplanorbis exustus*) acts an intermediate host for the above worm parasite and the disease is acquired by sheep or goats by their eating grass and leaves of plants which are found in the low-lying, water-logged areas and infested with the larval forms (encysted cercariae) of the parasite.

Treatment and control

The following is the line of treatment which has been found very efficacious in treating 'Pitto' and 'Gillar' in sheep, goats and cattle:

Five to ten c.c. of 10 per cent copper sulphate solution is administered by mouth and this is immediately followed by a dose of carbon tetrachloride, 1 to 3 c.c. for goats and sheep and 3 to 6 c.c. for cattle, preferably on empty stomach, the dose of the carbon tetrachloride depending upon the weight and condition of the animal. The carbon tetrachloride must be given mixed in sufficient quantity of rice gruel or linseed oil. The treatment may be followed with a saline purgative given the following morning.

From the above findings on the etiology, mode of infection and treatment of the disease, it will be rational to adopt the following control measures to check effectively the spread of the disease:

(a) Chemicals such as copper sulphate, calcium cynamide, slaked lime, superphosphate, etc. so as to destroy the snails, which act as intermediate hosts, may be broadcast from time to time.

(ii) The periodical removal of the weeds and floating vegetation of tanks and ponds will also reduce the snail population by elimination of numerous eggs deposited on these. Provision may also be made for suitable drainage to prevent water-logging. It is also worthwhile to check wherever possible the influx of snails through the canals etc.

(iii) Ducks may be introduced which would reduce the snail population.

(b) As far as practicable, rotational grazing may be encouraged by keeping each plot free at least for one year by which time the larvae would die. It is important to prevent the animals from grazing in the snail-infested swampy areas. Proper disposal of the dung may also be put into practice.

(c) In areas, where the disease is known to occur, the animals must be treated on the lines already indicated, at least thrice a year at an interval of about six weeks, after the rains, i.e., from the middle of September onwards.

IMPROVED SEMI-PERMANENT CATTLE SHEDS

By MALIK FAZL HUSSAIN

AT the Indian Veterinary Research Institute, Izatnagar, a large number of experimental animals, working bullocks, dairy stocks, sheep and goats are housed in temporary sheds made of cheap wooden poles and ropes and threads made of *bail* grass. Dry *bharra* and bamboos are used for roofing; obviously such a construction cannot possess any great stability or strength. These are nevertheless erected annually to provide shelter to the animals for at least a year against sun and rain and give protection against hot winds and cold winter. The expectation, however, seldom comes true. The fury of dust storms, which follow in the wake of closing summer, often blows the top away or brings down the modest structure. If the sheds can somehow stand the onslaught of the storm, they succumb to heavy or continuous downpour of monsoon rains. In these conditions the roofs invariably become leaky and, if the rain water happens to penetrate deep into base of the wooden posts, the structure collapses.

These exigencies are such constant features that every year a big sum of money is spent on the purchase of additional stock of *chappar* materials and on labour charges to repair the damaged sheds. It has been calculated that about half of the amount spent on the original construction has to be provided for repairs. Apart from the heavy cost of repairs occasional wholesale collapse caused injuries to animals and *gwallas* attending on them; these injuries are sometimes serious. Besides, when these sheds give way during a period of continuous downpour, the animals remain exposed to rain till labour can be mustered and the sheds re-erected. Such accidents to experimental animals seriously interfere with the progress of investigations.

In view of the limitations mentioned above, the Estate Section of the Institute has been engaged for the past few years in exploring ways and means by which these sheds could be improved. In this report, it is intended to record how the problem has been tackled and the success so far achieved.

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Pillar-type sheds

The main reason for the unstability of the sheds is the poor support offered by rather thin wooden posts, dug only a few feet in a soil of a pronouncedly sandy nature. The first consideration, therefore, was of their replacement by a more solid structure. Thick pillars, about one and a half feet square, made of *kachha* brick inlaid with fine clay (*chickni mitti*) answered the purpose admirably. *Kachha* bricks were prepared in the farm by our own labourers. The strong support enabled construction of a thicker roofing of *bhurra* grass which ensured against any leakage of rain water, even in heavy downpour. In Fig. 2, is shown the improvement introduced in the construction of the shed as compared to an old type shown in Fig. 1. It may be mentioned here that the illustration in Fig. 1 is a photograph taken of the old-type shed newly erected to give an idea of the merit of the new construction. The photograph in Fig. 2 is of an improved shed constructed three years ago, which has so far hardly required any repair except renovation of the roofing. The two figures further illustrate that compared to the bare sides all round in the old type, suitable pigeon-holed walls can be effectively provided in the terminal ends of the improved type of sheds.

Arch-type sheds

Although the introduction of home made brick-pillars brought about considerable stability in the temporary sheds, blemishes yet remained which demanded attention. The brick-pillars could eliminate the vertical wooden posts or *ballies*, but *ballies* were still required to be placed horizontally over the pillars to lend support to the roofing. The horizontal *ballies*, essential for the structure, were however very unsatisfactory materials for construction. The defects were that the *ballies*, except in rare cases, were not straight all through their length nor were they uniform in thickness. First class *ballies* without these defects were rare and their cost was prohibitive as compared to those of the average type. These defects in *ballies* also stood in the way of erecting heavier roofing which the innovations of pillars would otherwise permit. The frontal undulation of roof-end became inevitable due to the crookedness of *ballies*, at any points in their length and this marred considerably the trim look of the sheds. These defects were successfully removed by further improvement in the construction of the brick-pillars. The pillars were connected by arches. Over the pillars and arches was built a wall of *kachha* bricks of similar thickness up to a height of one and half feet. In view of the strong and smooth top-end of the walls, the use of horizontal *ballies* could be entirely eliminated. On this structure a thicker roofing could easily be spread, the roof-end maintained a straight line giving an elegant appearance to the shed (Fig. 3). The modified arch-type shed required no repair for four years. As *bhurra* grass rots by the fifth year, this was to be renewed for the roof at the end of the fourth year.

Relative cost of construction

The costs of construction of old-type and modified arch-type sheds have been calculated and found to be 2 annas and 6 pies and 6 annas per square foot respectively. In view of the fact that additional expenditure to the extent of about 50 per cent of the original cost of erection is involved in the repair of old-type sheds the actual cost incurred in the construction is about 3 annas and 9 pies per square foot which is almost 60 per cent of the cost involved in the construction of the improved sheds. The relative cheapness of 40 per cent loses all significance when one considers that old-type shed lasts for a year only, while the modified type would stand for at least four years with minor repairs. From the point of view of ultimate economy, elegance in appearance, stability of the structure and durability, the improved sheds have proved vastly superior to the old-type ones.

Because of the commodiousness of the improved type, it has also been possible to construct feeding troughs of a new design (Fig. 4) which is very suitable for individual feeding.

FROZEN MILK

AUSTRALIAN milk, quick-frozen, has been shipped to Japan for use of hospitals in the British Commonwealth Occupation Force area.

Quick-frozen milk is no novelty to Australia, as for many years it was sent from Adelaide, capital of South Australia, to the big mining town of Broken Hill, in inland New South Wales near the South Australian border. Some of this milk was tested 14 days after its production and there was no appreciable difference in flavour.—*Agriculture Newsletter*. Release No. AGR/167.

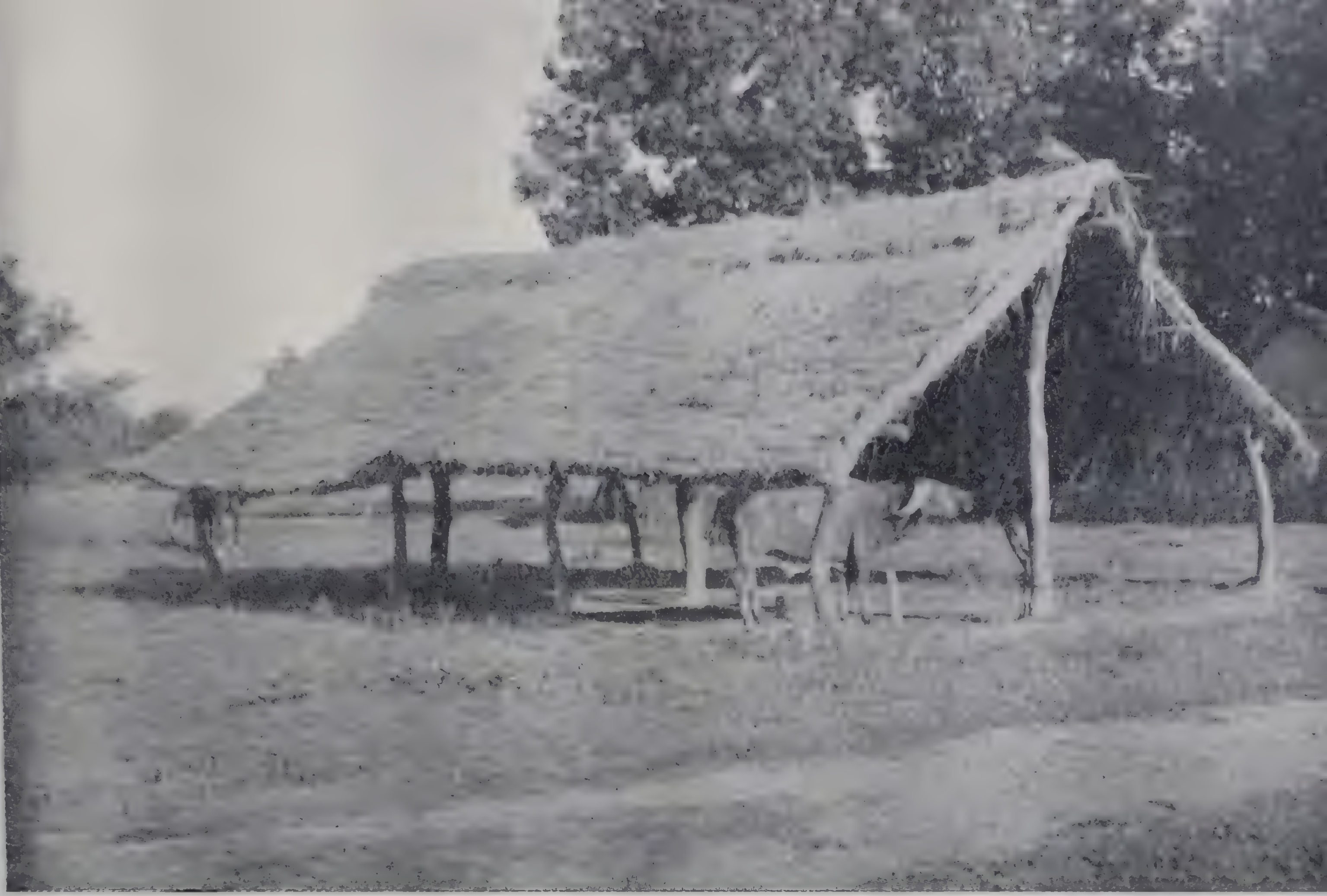
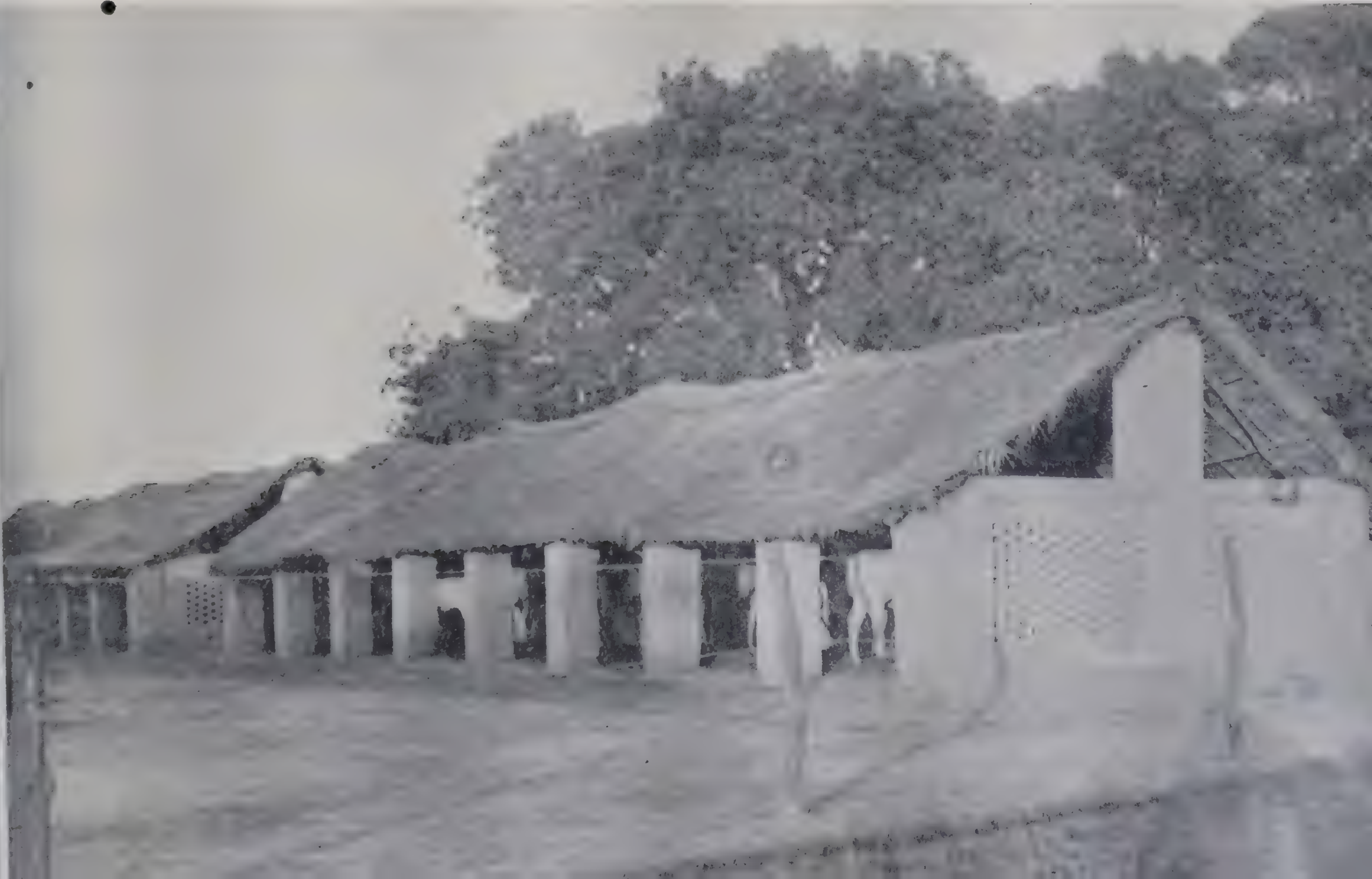


FIG. 1. (above). An old type shed

PLATE 4

FIG. 2. (below). An improved type of shed



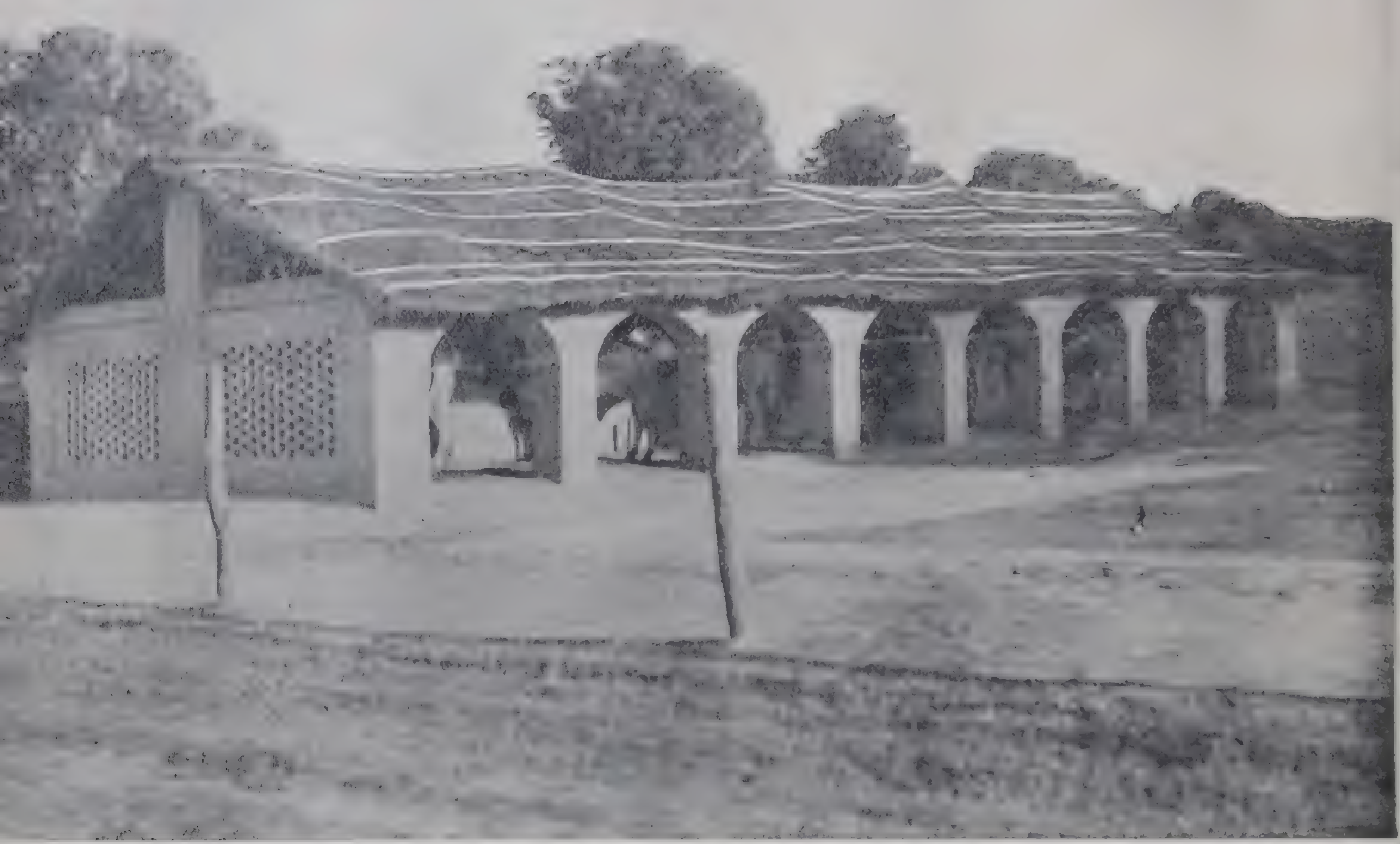
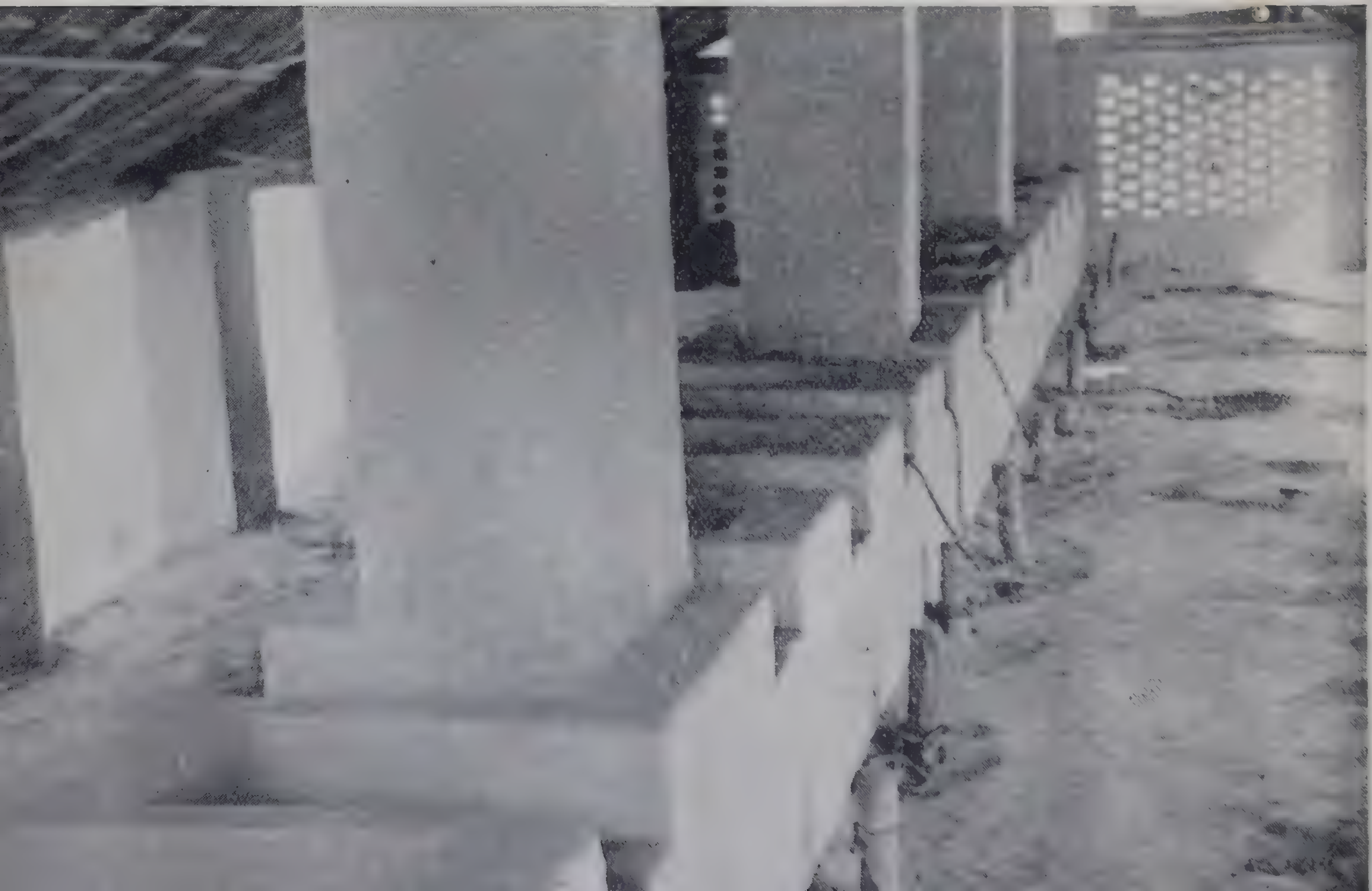


FIG. 3. (above). An improved type of shed with brick pillars and arches

FIG. 4. (below). Feeding troughs of a new design



What the Scientists are doing

FEEDING GROUNDNUT OILCAKE AND COTTON SEED TO CATTLE

RESEARCH work has been carried on in Baroda for ascertaining the merits of groundnut oil-cake as a feed to milch cattle and also for studying the comparative economics of feeding cotton seeds in balanced rations. Apart from grazing the following feeding stuffs were given to groups of Mehsana buffaloes and Kankrej cows : (i) groundnut oil-cake, (ii) groundnut oil-cake and cotton seed cake, 50 : 50, (iii) cotton seed, and (iv) a mixture of groundnut oil-cake (15 parts), cotton seed (50 parts), and *jowar* (35 parts). These animals were kept in two groups, a continuous and a switch-over one, each one having four sub-groups. In the continuous one, each sub-group received one of the above feeds, throughout the experimental period while in the switch-over sub-groups, the above feeding stuffs were given in a rotational order, altering the feed every two months, with an intervening period of 15 days between each change for effecting a smooth change over. It was noted that the daily milk yield and butter fat content were more in the case of the switch-over group in the case of the cows while the reverse was the case with the buffaloes. But it was observed that it was economical to feed them continuously on groundnut oil-cake than on groundnut oil-cake in combination with cotton seed, or on cotton seed alone or on a mixture containing groundnut, cotton seed and *jowar*. The cost of production of 100 lb. of milk and one lb. of butter on the above diets was more in the case of the cows than in the case of the buffaloes, thus indicating that the buffaloe was a more economical producer on these diets than the cow. As no ill effects were observed on the health of the cows or buffaloes by the use of groundnut oil-cake, the existing prejudice, if any, is likely to die out.—H.K.L.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Will you please tell me what steps are being taken to improve the method of collecting yield statistics?

A. In order to improve the method of collecting agricultural yield statistics and to place it on a scientific basis, the Indian Council of Agricultural Research has been conducting crop-cutting surveys since 1943, by the random sampling method, on an all-India basis, at the instance of the Government of India. The surveys were continued during the year 1946-47 on wheat in the provinces of the United Provinces, Bihar, Central Provinces and Berar, the Punjab, the North-West Frontier Province and Sind and on paddy in Madras, the United Provinces, Bihar, Central Provinces and Berar, Orissa and Coorg, on *jowar* in the Central Provinces and Berar and on gram and *masur* in Bihar. The feasibility of the adoption of the random sampling method for estimating the yield statistics, in the existing administrative set-up, was demonstrated by the Council to the Provincial Governments and statistical bureaus to take up the work were established by some Provincial Governments, while others took necessary steps in the matter. Special investigations as regards the optimum size of plot and the basis of stratification were also continued during the year under report. A scheme for determining the possibility of using the aerial photograph for estimating the area under crops was carried out in the provinces of the United Provinces, Bihar and Delhi during the *rabi* season 1946-47. The scheme will be continued during the *kharif* season 1947-48 in the United Provinces and Bihar.—I.C.A.R.

FIG. 1. R. I. Rs. in Gauhati Poultry Farm, Biruhari

FIG. 2. Ducks in the Gauhati Poultry Farm, Biruhari

PLATE 6

POULTRY DEVELOPMENT IN ASSAM

By V. R. GOPALAKRISHNAN

IT is a common practice in Assam, especially in the rural parts, to maintain and rear poultry and ducks. The upkeep is almost inexpensive and does not demand much attention. Most of the poultry are of indigenous breed and they usually fetch a fair price in the market. During the War, there was a considerable depletion of poultry population as there was a great demand for poultry and the price soared high. This resulted in a double disadvantage—first, many districts were practically stripped of their stocks which adversely affected breeding and production, and secondly, there was scarcity of additional protective foods, as in these parts poultry and eggs come next to fish in the routine popular diet.

So with the object of overcoming these difficulties and intensifying production, the Government of Assam formulated a scheme for poultry development under 'grow more food' campaign. The salient features of the scheme are to increase and multiply the present stocks, to improve the breed of birds of greater weight and better egg-laying capacity, to protect them against contagious diseases, particularly Ranikhet disease and fowl-pox, and finally to arrange for wider distribution of cockerels and hatching eggs to the public. It was realized that this was urgent and therefore new poultry breeding centres were started to step up production.

New poultry farms

Till recently, there was no separate poultry farm in Assam and it formed only a sub-section in the cattle breeding farm. But the requirements of the Province entailed increased production in independent poultry farms. So three poultry farms were opened in 1946 in suitable centres—Gauhati, Silchar and Dibrugarh, for breeding fowls, ducks, geese, etc.

The Gauhati Poultry Farm is located in Birubari, about two miles from the town. It was started in a discarded military camp and the houses were utilized with some little repair and modifications. There is also a tank adjoining the Farm, which facilitates the rearing of ducks and geese. Ample open space and yards are provided in addition to the pens located in shade under the trees. A plot of land is set apart for producing green vegetables for the poultry, especially during winter. In the Farm, there are at present nearly 400 birds ; about 300 of Rhode Island Reds and the rest consisting of ducks, geese and country fowls (Figs. 1 and 2). As it was found that Rhode Island Reds fowls were maintaining well in this locality, about 125 of these were obtained from the Indian Veterinary Research Institute, Izatnagar, in May 1947. Breeding and egg-laying have improved much in the Farm.

With a view to improve the breed and increase the production in the villages, hatching eggs are supplied to farmers at a concession rate of one anna each. Besides, cockerels are given free as well as on loan to responsible village poultry enthusiasts and private farms to encourage better breeding. Instructions regarding proper management, better feeding, disease control etc. are given by the Departmental officers while on tour. The villagers have understood the benefit of the scheme and their demands are on the increase. The scheme has really become very popular.

Disease control

Control of poultry diseases is important in any attempt to improve the breed and to increase the production. The major poultry diseases in the Province are Ranikhet disease and fowl-pox. They are undoubtedly the most

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serious diseases causing considerable losses. Fowl cholera prevails sporadically. It is, therefore, essential that all the birds in the farm should be protected against the two major diseases. Hence special arrangements were made to obtain Ranikhet-disease vaccine and all the birds were vaccinated. This was the first time when vaccination against Ranikhet disease was carried out in Assam. Similarly they were also immunized against fowl cholera. Since then no occurrence or outbreak of the diseases was observed. For other diseases control measures, both preventive and hygienic, are undertaken promptly and effectively. Immunized birds are issued to villages for breeding purpose.

Conclusion

The scheme for poultry development was started on a temporary basis for five years under 'grow more food' campaign. But its planning and working were so economic and methodical that it has gained much popularity. There is an ever growing demand for poultry and poultry products in this province. The nucleus of production and supply started at Gauhati has attracted sufficient attention and demands are coming in not only from the urban and rural areas around but also from various parts of India and even from far-off places like Rangoon. With growing popularity and useful service to the public, the scheme is paving its way for permanency.

SOME SCIENTIFIC AND PRACTICAL ASPECTS OF INDIAN AGRICULTURE*

By J. N. MUKHERJEE

AFTER mentioning that so far as he was aware the late Dr Aghornath Chattopadhyaya, father of Her Excellency Mrs. Sarojini Naidu, was the first Indian to obtain the degree of Doctorate of Science of a European university he said that the pioneering contributions to modern science made by Acharya Jagadish Chandra Bose and Acharya Profulla Chandra Ray dispelled the doubts expressed at one time by Europeans in India whether people with so vivid a literary imagination could easily master modern science. He then referred to the inspiration succeeding generations of science students derived from Acharya Bose, whose life was fully dedicated to the service of science. He also paid a tribute to Lady Bose.

Introducing the subject of his lecture, namely 'Some scientific and practical aspects of Indian agriculture', he referred to the critical period through which we were now passing and said that all possibilities for economic and social progress have been rendered extremely difficult by the drain on our financial resources necessitated by the importation of foodstuffs from abroad. He pointed out that the problems of production of food and raw materials for industries from the land are part and parcel of a more comprehensive proposition which is the preservation, beneficiation, and ecologically balanced utilization of our natural resources, of climate, soil, water, and of plant and animal life. He then referred to the widespread resource depletion and impairment, and the problems arising out of the high density of population in several parts of the country. The stupendous task of maintaining a dense and increasing population and of, at the same time, raising their standard of living faces the people of our country. While dealing with the conservation of natural resources, he suggested that a statutory permanent organization at the highest level of science and administration was necessary to ensure continuity of policy. Such an organization might be a necessary part of a National Planning Board.

Background of agriculture

He next discussed the scientific background of agriculture and the importance of ecological studies, which in its broader sense include the study of man in relation to his environment. He referred briefly to the bearing plant and

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*Summary of the ninth Acharya Jagadish Chandra Memorial Lecture delivered by Dr. J. N. Mukherjee, on 30 November, 1947, at the Bose Institute, Calcutta animal ecology has on the production and protection of crops, and to the importance of climatic surveys, ecological plant geography, and the distribution of soil zones, soil groups and soil types. Our aim should be to build up a permanent agriculture, features of which are to be determined by complex ecological relationships. Soil fertility, its improvement and maintenance at an optimum level, is of the utmost importance in our national economy. The Famine Enquiry Commission estimated that we had 0·67 acre *per capita* in 1944. The maximum possibility of increasing this is to add another 0·3 acre. With the increase in population the acre *per capita* has been continuously decreasing. Hence we must get as much out of every unit of land as is possible. In doing so we must not impair or lose the land itself. He discussed how a balanced crop rotation, in which cereals and cash crops, which deplete soil fertility, are rotated with legume and/or grasses, improves and builds up soil fertility. Balanced crop rotation is essential for permanent agriculture. He pleaded that experiments on crop rotations should be integrated with varietal and manurial trials, and with solid surveys. In his opinion the set up of commodity committees, although they serve many useful purposes, unfortunately detracts attention from the general problems of agriculture and particularly soil productivity and the cropping system underlying agriculture as practised by the Indian peasant. It is a defect of scientific approach which calls for remedy. The distinct study of the soil as such is necessary and soil studies should not be conducted piecemeal by the different commodity committees in relation to the needs of individual crops. Soil science does not recognize classification of soils on the basis of crops.

Programme of work

He then briefly referred to the need of an immediate programme of work for increased food production and an intensified effort to achieve this. The point he made was that the primary producer lives scattered in several lacs of villages. His enthusiastic and active cooperation should be enlisted. He mentioned an important omission in the set up of the Agricultural Departments of India as compared to that of other countries, such as the United States, the United Kingdom, Canada, Australia, etc. where the County Agent or the Agricultural Inspector functions as a link between the farmer on one hand and Agricultural Departments on the other. During the War, the United Kingdom stepped up crop production by about 70 per cent and the United States achieved about 90 per cent of their contemplated target of food production. We may study their organization for effecting this increase in production.

For the immediate programme we have to utilize the knowledge which the efficient farmer has and that which is available at our experimental stations together with established scientific conclusions. We have not got sufficient supply of farmyard manure and oilcakes, whose manurial value has been proved, nor can we import all the fertilizers we require as they cannot be had even if we had money to pay for. We must, therefore, concentrate upon the best utilization of whatever resources in manures and fertilizers we can secure and use, so far as is possible, green manures, which have been used by the Indian peasant for generations. Experiments in India and abroad have shown that green manures fertilized with phosphate definitely build up soil fertility. Also legumes have been found which, when fertilized with phosphates, not only increase the yield of subsquent crops as a result of improvement in soil fertility but also supply rich fodder. Some of this knowledge can be put into practice in our immediate programme. He then referred to, among other things, the difficulties which confront a large fraction of the tillers of the soil which prevent them from deriving the best advantage from the practices of the good peasant in his own village. He referred to the great variations in yield in the same variety of crop in the same village. While part of it is due to innate soil differences, all of it is not attributable to this cause. The experience of the best peasants, as also of our experimental stations, show that for many crops the innate productivity of our soil is very high indeed. It, therefore, behoves us to ascertain to what extent the low productivity of the soils managed by many peasants arises from the remedial causes. Our immediate programme of work should be to remove these, so far as is possible. For example, timely cultural operations mean a good deal in terms of yield. The possibility of increasing the intensity of cropping was also mentioned. In short, it was suggested that the centre of our activity should be in the villages and the ecological background, which makes us understand the mutual relationships of factors underlying rural economy, should be kept in the foreground.

It was emphasized that the immediate, 'near immediate' and the 'long term' programmes of work should be integrated.

THE INDIAN CENTRAL COCONUT COMMITTEE AND ITS ACTIVITIES

THE Indian Central Coconut Committee was set up in February, 1945 and in the course of the last thirty months it has initiated schemes that, from the immediate as well as the long range points of view, are designed to increase the production of coconuts, improve the marketing of copra and encourage research into the cultural, manurial and disease problems of the coconut palm.

Distribution of quality seedlings

One of the first things which the Committee took up was the question of distribution of coconut seedlings of guaranteed quality to growers. Having regard to the fact that the coconut tree is a perennial one which takes about 8 to 10 years before it starts bearing and lives up to an age of 80 years, the importance of planting seedlings of guaranteed quality cannot be over-emphasized. Any mistake in this regard could be discovered only after 10 years when already much labour and money would have been spent on the tree; it is, therefore, of the utmost importance to select the right type of seedlings. There is a regular and big demand for coconut seedlings from growers in the producing areas but there are no reliable private nurserymen who could supply seedlings of guaranteed quality. The Committee, therefore, sanctioned schemes to start coconut nurseries at various centres in collaboration with the Provincial or State Governments concerned. Thus, as from 1 January, 1946, nurseries were set up at Samalkot (East Godavari District) and Pattukottai (Tanjore District) in Madras Province, Puri in Orissa, Arsikere in Mysore State and Vaikom and Kazhakuttam in Travancore State. A seventh nursery was started at Irinjalakuda in Cochin State on 1 September, 1946, and an eighth at Pattambi (South Malabar), Madras Province, on 1 September, 1947.

Steps are being taken to start a nursery at Kumti (North Kanara District), Bombay Province, to serve the needs of growers in the Konkan area while a scheme to set up a nursery at Tezpur in Assam Province is under consideration. The Committee has recently received for consideration from the Madras Government a comprehensive scheme for the establishment of coconut nurseries in eight important centres of the Madras Province (including three already functioning) for the supply of about 1,60,000 selected quality seedlings to the public every year instead of the limited quantity of about 25,000 seedlings at present. The additional nurseries have been proposed to be located at the Agricultural Research Stations at Nileshwar (South Kanara), Aduturai (Tanjore), Maruteru (West Godavari) and Anakapale (Vizagapatam) and the Central Farm, Coimbatore.

The existing nurseries are all for a period of five years from the date of commencement and their total output of seedlings for the period is expected to be of the order of 330,000.

The Committee contributes 50 per cent of the recurring expenditure in respect of the nurseries, the other 50 per cent and the non-recurring expenditure being met by the Provincial or State Governments concerned. It has been stipulated that seedlings are to be sold only at a minimum age of nine months and at four annas each.

Agricultural Research Schemes

As from 1 January, 1946, the Committee has taken over from the Indian Council of Agricultural Research its share of liability in respect of two important research schemes the Council was financing.

The first of these, the scheme of Research on Coconuts in Madras, has for its main objective the establishment of criteria for the selection of seedlings that would ultimately grow into high-yielding trees, the study of the copra and oil content of coconut in relation to the bearing capacity and morphological characters of the trees and the investigation of the quality and quantity of copra, oil and fibre obtained from nuts of varying stages of maturity. The botanical problems and field work connected with the scheme are carried out at the Coconut Research Stations, Kasaragod, Pilicode and Nileshwar (South Kanara District, Madras Province) while the chemical work and coir investigations are conducted in the laboratory of the Oilseeds Specialist, Coimbatore.

The other scheme is for investigations on the diseases of the coconut palm, particularly the root and leaf diseases, which are widely prevalent in the Travancore and Cochin States, and is worked under a Plant Pathologist at Quilon (Travancore).

Besides the above, active steps are being taken to start under the Committee's direct control two Central Research Stations, one at Kasaragod (South Kanara District, Madras Province) for work connected with fundamental research and with the botanical and genetical aspects of coconut cultivation and the other at Kayamkulam (Travancore State) for investigations connected with the control of pests and diseases of the coconut tree. The foundation stone of the latter station was laid in April, 1947, by His Highness the Elaya Raja of Travancore.

There is also a scheme to start Regional Coconut Research Stations to serve the needs of particular areas. Three of these will shortly be set up in Travancore. They will deal with the cultural and manurial aspects of coconut cultivation. The Committee has agreed to meet 50 per cent of the recurring expenditure of the Regional Stations, the other 50 per cent and the non-recurring expenditure being met by the Provincial or State Government concerned. The Travancore Government have agreed to set up three Regional Research Stations in Travancore.

Two cooperative societies for the marketing of copra are being financed by the Committee; one is at Vaikom in Travancore and the other at Narakkal in Cochin. It is proposed to establish a hot air kiln in the premises of each of the two societies for drying copra.

With a view to drawing up accurate grade specifications and standards for copra and coconut oil, the Committee has sanctioned a scheme for the collection and analysis of trade quality samples of copra and coconut oil from various parts of the country. Specifications and standards will be drawn up by the Central Marketing Department when the analyses of samples are completed, which it is hoped, will be done by May, 1948.

As regards research on problems of coconut technology, the Committee appointed as early as September, 1945, a special Sub-Committee to report on the question of setting up the Committee's own Technological Laboratory. This Sub-Committee, while feeling convinced of the necessity for such a Laboratory, suggested that before specific proposals could be made it was desirable to make a study of coconut technological work being carried out in Ceylon. Accordingly the Committee deputed to that country a three-man delegation whose Report was considered in October, 1946. As a result, the Committee has decided to set up a Technological Laboratory of its own but in view of its present financial position, the question of the construction of the Laboratory has been deferred for the present. In the meantime attempts are to be made to interest Indian Universities to undertake research into some of the problems aided by grants from the Committee.

In co-operation with the Provincial or State Governments a ' grow more coconut ' campaign is being organized in order to wipe out the present deficit between the production of, and demand for, coconuts and coconut products in India.

From August, 1947, the Committee has started publishing a *Bulletin* in English and Malayalam furnishing market intelligence and other useful information to those interested in the coconut industry. The *Bulletin* is widely circulated and is proving a popular publication. A *Hand-book on Coconut* is under preparation while a quarterly periodical entitled *The Indian Coconut Journal* is to be brought out shortly.

Across the Borders

IMPORTANCE OF FARM DRAINAGE

By E. G. SMITH

THE provision of adequate drainage is overlooked on many properties where the need for it is obvious. Land is often seen overgrown by rushes—usually an indication of poor drainage. Many paddocks lie wet through winter and spring with the result that production is reduced to a marked extent.

Surplus water should be drained from the land, otherwise pasture growth is checked and cultivation is frequently delayed to such an extent as to make the sowing of a crop impracticable. Furthermore, if crops are sown under wet conditions, root development is restricted and the crop is slow to establish, resulting in a reduced yield. On the other hand, if suitable drainage has been carried out, less cultivation is required and crops may be sown earlier in the season. Drainage improves the physical condition of the soil and therefore land from which excess water has been removed retains the necessary soil moisture during a dry period.

A well-drained soil warms quickly in spring and retains its warmth much later in the season than a poorly-drained one. On well-drained land the response to lime and fertilizer is not only quicker but is more lasting, as less leaching occurs.

It is therefore obvious that where drainage is improved both plant growth and stock-carrying capacity are automatically promoted. Pasture growth commences earlier in spring and carries on later in the year, resulting in the production of more fodder. It is a well-known fact that stocks thrive and require less feed when conditions are warm and dry.

The natural soil moisture is removed only by evaporation and plant growth. Various methods of drainage have been advocated and many have proved successful. However, few set rules can be laid down and farmers must be guided by local conditions.

Methods of drainage

The water furrow. A popular method of drainage on the arable Canterbury farm is the water furrow. Although this proves useful in removing surface water, it is a poor substitute for real drainage, especially as it is frequently used on land that should be either tile or mole drained.

Mole drainage. The mole drain is lasting and effective only where the subsoil is of a uniform stiff clay and where a satisfactory fall can be obtained from top to outlet. Under these conditions mole drainage can be highly satisfactory for a number of years, and installation costs are low. The mole drain plough is not a dear implement and its cost is usually shared by a number of farmers in a district.

The mole drain is simply a tunnel drawn in the subsoil, usually 14 to 22 in. below the soil surface. It is formed by the torpedo-shaped plug attached to the mole drain plough. The diameter of the plug varies in size from 1 to 4 in., but it is generally found that a 2 in. plug gives satisfactory results.

Mole drainage should be undertaken when land is in good permanent pasture, but it will generally remain effective on a ploughed area. The drawing of drains is best carried out when the surface soil is dry and the subsoil is moist, as this gives a clean mole with a minimum of surface damage. If the work has been efficiently carried out, silting usually occurs only at the outlets, and it is therefore advisable to use only one in every five or six moles as an outlet. This is accomplished by making, say, every sixth mole cross the lower ends of the preceding five. When this is done it is necessary to dig down at the intersections to clear the ends of the intermediate drains. A tile should be placed at each outlet. Mole drainage is dealt with fully in Bulletin No. 170, 'Mole Drainage' which is available from any office of the Department of Agriculture.

Open drains. The open drain has many disadvantages, for example, danger to stock, the necessity for constant attention, and difficulty experienced in cultivation and top-dressing. However, when run along fence lines or on peat land where a solid bottom cannot be obtained these drains serve a useful purpose.

Fascine drains. Fascine drainage has been widely used in districts where suitable scrub is obtainable. Material such as munuka is tied in bundles and placed in an open drain so that the brush of one bundle covers the butts of the next. To avoid rotting of the scrub it is advisable to tile 3 or 4 yards at the outlets.

Stone drains. The stone drain has been used to a limited extent. Under this system stones are placed in the bottom of the trench and are usually covered with scrub or straw before the trench is filled in.

Slab drains. The slab drain was popular when timber supplies were plentiful. It is formed by placing a wooden slab across a narrow channel cut in the bottom of the trench.

Tile drains. Where a solid bottom can be obtained and mole drainage is not practicable the tile drain will generally be found to be most effective. Although it requires very little fall, care must be exercised to ensure that there is no loss of fall from the highest point to the outlet, as this would result in the tiles silting up. For satisfactory results the bottom of the tile trench should be of a width just sufficient to permit convenient laying of the tiles ; a wide trench allows displacement of tiles.

No rigid standard can be laid down regarding the most effective depth of drains and the distance between drains. Therefore when the drainage system is likely to be an expensive one the farmer who has had no previous experience should drain only a small area until reliable local knowledge is obtained.

Whatever method of drainage is used, a careful study of the area to be drained is necessary for success. Time spent in the taking of levels and the consideration of suitable outlets is well spent. Care must be taken to ensure that the drain is of a depth sufficient to avoid damage during cultivation. Paddocks require both individual and collective consideration and when the system is planned future expansionshould receive due attention.—Reproduced from *N. Z. Journal of Agriculture,* **71** (June), 1947.

Home Gleanings

HUMAN AND CATTLE NUTRITION IN INDIA

By I. CHATTERJEE

IN order to form a proper idea of the interrelated problem of human and cattle nutrition in India, it is necessary to understand the scope and limitations forming its special features.

Population

India has a human population the density of which on the basis of British provinces is 342 and on the basis of India as a whole 246 (according to the 1941 census), but this density, or even the average density by provinces and States can give only a partial idea; for, it varies from 9 in Baluchistan to 40 in Jammu and Kashmir, 130 in the Indian States as a whole, 154 in Gwalior, 170 in C.P. and Berar, 186 in Assam, 198 in Hyderabad, 213 in the North-West Frontier Province, 249 in Mysore, 271 in Orissa, 272 in Bombay, 287 in the Punjab, 518 in the U.P., 521 in Bihar, 779 in Bengal, 792 in Travancore and 953 in Cochin. As, owing to the war, the 1941 census could not probably cover all aspects, some of the features from the 1931 census are also referred to here. According to these census, the density was at its highest at 2,000 per square mile at the most thickly populated parts of the south-west coast, reaching the amazing figure of 4,000 persons in one of the Cochin villages. The density is heavier in Cochin, East Bengal, the north-east of U.P. and Bihar. In all these places the rainfall is heavier than in other parts of India, with the exception of Assam, where large tracts of hills and forests reduce the population in proportion to area. The province of Bengal, as at present constituted, is ninth in area and first in respect of population. Excluding Calcutta, the density was recorded at 2,657 in the Howrah District, 2,497 at Munshiganj and 3,228 at Lohganj Thana, in the Dacca District. In Bihar, which adjoins Bengal, the density is very heavy, being 1,000 in Patna, Saran, Muzzaffarpur and Darbhanga districts and about 600 in South Bihar. Only Santhal Parganas have lesser density.

India is largely a country of small cultivators who follow a traditional way of life. Cereal grains, rice, wheat and millets form the most important items of their food and pulses are a supplement to most Indian diets. For the purpose of food supply and its effect on the people the country may be treated as having rice region, wheat region, millet region and a mixed region. It will be self-evident that the types of food in the respective regions have much to do with the health and physique of the people.

Cattle

According to the census of 1941, India recorded a total bovine population of 208·2 millions the largest in the world. The condition of cattle has much to do with the quality and quantity of food available and along with the cropping conditions of the regions the rainfall and climate also serve as a determining factor. Thus there are areas which may be considered as wet regions with heavy rainfall (from 70 in. to 100 in. or more), areas of medium rainfall (from 30 in. to 60 in.) and dry regions with rainfall of less than 30 in. It is estimated that the milk yield is 370 lb. in the first, 462 lb. in the second and 773 lb. in the third region per animal. Moreover, the milk yield is low everywhere and only a small percentage are economic breeders. The yield is lowest in those regions where the density of human population is highest.

Nutritional status of human population

A survey of the nutritional status was conducted about 1937 by Sir John Megaw. Its relevant features are set out in the following table:

TABLE I

Province	Total population dealt with	Average No. of acres cultivated per family	Average No. of members of each family	Percentage of well-nourished	Percentage of poorly nourished	Percentage of very badly nourished	Average consumption of milk by each adult (oz.)	Infant mortality during first year	Maternal mortality	*Ghee* consumption *per capita* as ascertained by Sir Johan Megaw
Assam	22,552	6·9	5·6	53	38	9	2·3	250	26·4	0·6
U.P.	52,055	9·6	5·4	40	39	21	5·0	303	18·0	0·6
C.P.	85,351	16·5	5·0	32	50	18	0·8	296	8·2	0·2
Madras	2,78,377	6·3	5·0	46	36	18	1·7	198	13·2	0·3
Bengal	93,921	5·0	5·5	22	47	31	1·9	189	49·2	0·1
Bihar	35,748	5·7	5·8	42	40	18	3·2*	242	26·6	0·2*
Punjab	1,08,813	17·3	6·2	42	38	20	10·0	206	18·7	1·2
Bombay	68,700	13·8	5·2	45	44	11	4·0	214	20·1	0·2
Average for British India	..	8·4	5·4	39	41	20	3·5	232	24·5	0·32

(*) Including Orissa

It will be seen from it that taking India as a whole about 41 per cent are poorly nourished and 20 per cent very badly nourished. This means that over 240 out of 400 millions of the population are either poorly or very badly nourished. In the case of Bengal 47 per cent and 37 per cent are under these two categories. In other words 78 per cent or above 47 million out of 60 million people of this province are either poorly or very badly nourished. Judging the figures from another angle Bengal has the lowest well-nourished people, viz. 22 per cent as compared to 32 per cent in the C.P., 40 per cent in the U.P., 42 per cent in Bihar and the Punjab, 45 per cent in Bombay and 53 per cent in Assam. Megaw's report further states that in 40 per cent of the Indian villages the population is excessive in relation to the food supply. In Bengal, it is considerably more. The data suggests that 80 per cent or double the average of the whole of India are poorly or very badly nourished. Overcrowding is one of the main reasons for such a state of affairs. An idea of this overcrowding can be formed from the simple fact that the Presidency and Burdwan Division contain a population more than that of Bombay Province, Baroda State and the Gujerat and the Deccan States taken together. Dacca Division has a population larger than Assam and Orissa taken together while Chittagong Division has a population equivalent to Travancore and Cochin taken together. According to Sir Manilal Nanavati and Anjaria, 30 per cent of the Indian human population (i.e. 120 millions) are crowded under 6·4 per cent of the area (42 million acres) with a density of 600 and upwards. As a matter of fact some areas had exceeded this limit by three-fold, four-fold and even more. It is in these areas that the production and standard of living are at the lowest level.

Effect of low nutrition

Some time ago Lord Ronaldshay had remarked that in India there was a baffling weariness of spirit imprinted on the face of everyone. In fact it is a common experience to meet dull-looking listless boys and girls almost everywhere. The cause of it is traceable to the poor food supply in quality and quantity. Under such conditions, the vigorous faculty of intellectual thinking becomes naturally confined to a few, leading to a belief and resignation to fate as if the eminence of the latter and the poor conditions of rest were ordained by it. Actually generations of malnutrition and absence of vitally essential food fators have worked in such a way that not only is chronic poverty an inseparable accompaniment, but it has bred poverty of thought, ideas and action. This condition has an analogy with the recent famine in Europe in connection with which Sir Jack Drummond (*Journal of the Royal Society of Arts*, Vol. XCIV, No. 4720, June 2, 1946) remarks that when energy supply falls below 1500 calories, psychological changes are reflected in irritability and apathy. 'The apathy becomes so general that interest in everything other than the acquisition of food and the search for warmth is almost obliterated'. The effect on the mental process is such that it 'tends to obliterate the social sense and responsibility' and the last stage of this degradation was seen in the thousands of living skeletons in the Belsen and other Horror Camps. If such could be the position amongst people who were originally better fed one can well imagine the far-reaching effect under conditions in which the food supply has for generations suffered not only in quality and quantity but where the food habits have been shaped amid environments in which superstition, poverty, ignorance, tyranny of customs, fanaticisms and a multitude of factors have combined to create a situation in which what is even possible is only done indifferently, wastefully, unhygienically and even sometimes suicidally. The result is that the food sources, limited and meagre as they are, find the poorest utilization. The following table gives the picture in terms of present available amount and minimum requirement :

TABLE II

	Ounces per day per adult (or consumption unit)		Total quantities in million tons	
	Required for a balanced diet	Available	Required	Available
Cereals ..	18	17·5	54·0	52·5
Pulses ..	3	2·5	9·0	7·5
Sugar ..	2	1·8	6·0	5·3
Vegetables ..	6	3·0	18·0	9·0
Fruits ..	2	2·0	6·0	6·0
Fats and Oils ..	1·5	0·6	4·5	1·9
Whole milk ..	8	1·5	32·0	6·3
	per capita			
Butter milk ..	..	3·0	..	12·5
Meat, fish and eggs	2·3	0·5	6·0 to 9·0	1·5

It should be stated that this table does not give what dieticians may consider as ideal requirements. In fact from this standpoint it leaves much to be desired but it will not be possible to attain even this limited target unless the problem is attacked from all angles with a concentrated endeavour.

Nutritional status of cattle

No survey of the type undertaken for human population has so far been done for cattle or other animals ; but the position could be judged from other sources chiefly from the available food supply. This broadly consists of roughages (from cultivated fodders, grasses and straws) and concentrates such as oilcakes and other bye-products. The amount of roughages available works out to 7·37 lb. dry matters per head in the wet region, 9·42 lb. in the moderate region and 15·17 lb. in the dry regions, whereas the concentrates available are 0·14 lb., 0·19 lb. and 0·38 lb. respectively in these three regions. As opposed to it the actual need of roughages and concentrates together is 11·5 lb., 13·75 lb. and 16 lb. respectively in the three regions based on the body-weights of the animals. When these are worked out it is found that the average supply can meet the need of only 29·14 per cent in the case of concentrates and 78·52 per cent in the case of roughages. There is thus a heavy deficiency and it is greatest in the areas where fodder area is low and rice straw is the main source of roughage. The following table presents the notable features in some of the provinces :

TABLE III

	Total dry matter available per head per day	Percentage of total cultivated land devoted to fodder crops	Number of cattle per acre of cultivated fodder crops
Bengal ..	2·5	1	126
Bihar and Orissa	3·5	7	12
United Provinces	3·9	9	9
Madras ..	4·0	2	49
C.P. and Berar ..	3·5	3	23
Bombay ..	8·0	13	3
Punjab ..	8·0	22	2

It will be seen from this table that there is a short supply almost everywhere but in some provinces it is alarmingly low. The result is that the animals live on the border lines of semi-starvation and the majority 'are of the non-descript nature'. Through inadequate feeding, indiscriminate breeding, indifferent management and through ravage from disease, the net output from animals is one of the lowest in the world.

The rice tracts of India are widely distributed but there is a striking similarity all over of the health and physique of both man and animal. In such widely scattered areas as Kangra District in the Punjab, in the valleys of Kashmir, in the Gorakhpur District of U.P., Raipur in C.P., Tanjore in Madras and in the predominantly rice tracts of Bihar, Bengal, Orissa and Assam, the cattle are invariably poor and less efficient and the number of bullocks (and necessarily of men) per 100 acres of net sown area is about 3 to 4 times as in other areas. The rice areas suffer from other formidable handicaps. The poor rice eater obtains about one-tenth of the calcium he needs and this insufficiency is the most serious factor reflected in short stature and weak bones of the rice-eating people. The method of cooking, washing and throwing of water after boiling involves a loss of 10 per cent of protein, 75 per cent of iron and 50 per cent of calcium and phosphorous and 15 per cent of that part of energy which is most assimilable. The loss of such a large percentage of energy is the most disquieting feature in the cooking economy of rice.

The rice areas have also other disadvantages. In some areas people have prejudice against the use of par-boiled rice. These areas include north-east coast of Madras Presidency and the Northern Sircars including Ganjam, Vizagapatam, Godavari, Krishna, Guntur and Nellore districts. In these areas Beriberi has become endemic. In the Northern Sircars about 30,000 cases occur annually resulting in the death of 40 to 90 persons.

The State of Travancore which is another rice area with the highest density of population tapioca has become a substitute food, especially amongst the poorer classes. This has helped the people to escape famine but it is leading to a progressive deterioration in the physique and had increased incidence of, and susceptibility to diseases of various kinds.

Solution of the problem

In the face of the immensity of the problem the solution may appear almost baffling. The solution mainly lies in a self-sufficiency of food and increased purchasing power of the masses. In so far as the food supply is concerned the target has been put to increase cereals by 10 per cent, of pulses by 20 per cent, of fats and oils by 250 per cent, of fruits by 50 per cent, of milk by 300 per cent, of fish and eggs by 300 per cent, of concentrates by 400 per cent and of fodders by 55 per cent. Improved seeds, artificial fertilizers, increased irrigation facilities, supply of insecticides and fungicides are matters to which all provincial governments and States are paying attention and various plans have been drawn up to speed up progress. The matter bristles with many difficulties in which socio-religious alignment of the people, the extreme fragmentation of holdings, the laws of inheritance, the tenancy system, the problem of absentee landlordism have all to be tackled properly and simultaneously in order to lay the foundation of a better and healthier and prosperous India.—Reproduced from *Perspective*, July 1947.

Book Reviews

COMMODITY EXCHANGES

By P. G. Salvi (Co-operative Book Depot, Bombay).

THIS is a timely book. The experience of the last few years has demonstrated how essential is marketing in general and of agricultural produce in particular. Without efficient links organized in modern way with necessary technique and devices the community will be ill-served. Neither producer, nor consumer, and clearly not the nation benefit by over-loaded anti-deluvian and outmoded methods of merchandizing. The whole problem is extremely complicated. Mr. Salvi has industriously analyzed the entire mechanism relating to various basic commodities and indicated the function and manner of operation of the various trade and merchants associations. The book may prove a little difficult and dull for the layman. This is one defect which might be improved in the next edition. But for the expert and the initiated it should prove useful. Comparative study of market organization of various countries will be found helpful.—S.K.R.

⁂

NEW BOOKS RECEIVED

1. *How You Can Help in This Food Crisis* (Published by Madras People's Food Council, 8, Westcott Road, Madras, 14, 1947, pp. 29, Re. 1).
2. *Rights of Ryotwari Tenants* by K. G. Sivaswamy (Published by South Indian Federation of Agricultural Workers' Unions, 8, Westcott Road, Madras 14, 1947, pp. 31, Re. 1).
3. *Serfs of Kathiawar* edited by U. K. Oza (Published by Sadhana Services, Rajkot, Kathiawar, pp. 18, As. 4).

News and Views

PLANNED BREEDING OF HIGH GRADE COWS

By EGON LARSEN

ON the average a normal bull fertilizes a cow with from 50 to 100 times as many 'seeds' as would be necessary for conception. During the last two or three years the recognition of this simple fact has brought about an epoch-making new development in British agriculture.

In 1944, Britain's Milk Marketing Board, an organisation representing dairy farmers, began to interest itself in the artificial insemination of cows. The basic idea was to encourage the planned breeding of high-grade milch cows directly World War II was over, the purpose being not only to increase milk production in Britain but eventually to supply the whole world with samples of the most famous breeds.

The Milk Marketing Board has published recently its latest report on the progress of artificial insemination in Britian. The experiment is developing at an extraordinary rate, for the British farmer, usually so conservative, has been quick to join the new movement and to recognise the great advantages it offers.

Low costs

The principal advantage is that the farmer, from the important landowner down to the small farmer, has an absolute guarantee that his cows will be fertilized by first-class and absolutely healthy prize bulls. The costs of this service are very low. In one sense, indeed, it is a 'sale or return' service, for if the first insemination should prove ineffective up to two further injections are supplied without charge.

In this way, too, the spread of certain contagious animal diseases can be largely checked and the butterfat content of the milk systematically increased throughout Britain. Yet another great advantage is the fact that the individual farmer no longer needs to handle the bull himself, often a dangerous proceeding.

The rapid growth of the movement among British farmers can be seen from a few figures. Within one year, from April 1946 to March 1947, the number of 'subscribing' cattle-breeders rose from just under 1,000 to almost 5,000. During the same period, the number of artificial inseminations rose from 6,500 to 25,500. The annual number of inseminations per bull is at present approximately 700. In the view of experts the maximum figure possible is up to 4,000, according to the fertility of the bull and the extent to which it is desired to use him; but the immediate target is in the neighbourhood of an average of 1,000 inseminations per bull per annum.

Cattle-breeding centres

The bulls are kept at nine main cattle-breeding centres. It is hoped to establish 24 of these centres throughout Britain, the largest containing up to 30 bulls. The animals are lodged in spacious, spotlessly clean stalls and are carefully tended and taken out to grass each day. Each main centre has laboratories, sterilising rooms and isolation stalls.

Subsidiary centres are run in conjunction with the main centres and are kept supplied with fresh 'seeds' at regular intervals. These subsidiaries serve cattle-breeders situated more than 10 miles from the main centre. The breeder telephones in the morning and his cow is artificially inseminated in the afternoon.

At the main centre the seeds are examined under a microscope for fertility immediately after they are obtained. The supplies are then taken to the cattle-breeders in trucks, accompanied by an experienced inseminator. The cow to be inseminated should preferably be waiting ready in her stall. The operation, which only takes a few minutes, is carried out with the aid of an inseminating rod. The inseminator wears rubber boots and an apron, while the cattle breeder stands by with water, soap and towel. The strictest hygiene is an absolute condition for success. On the average out of 100 cows artificially inseminated, 64·6 become pregnant — a figure which is at least as good as that obtained with natural insemination.

Democratic movement

Artificial insemination can play an important part in upgrading high-grade herds, since the territory in which good bulls can propagate their strain now covers the whole of Britain. Cattle-breeders who previously could not afford to keep or use pedigree bulls now have no need to fall short of the large-scale breeders as regards the quality of their animals. In this sense the new movement is truly democratic. Up to the present no disadvantages have made themselves apparent.

Scientific research in the field of artificial insemination is now proceeding with doubled energy. The centres now act as 'field laboratories', where a long series of problems are brought for solution, such as the study of the dilution rate of the seed, and the effect of storage on the conception rate. Many of these problems overlap. Thus it has been found that seed four to five days old, diluted at a rate of one to 20 (in egg yolk and a phosphate solution) is more effective at a temperature of five degrees Centigrade and retains its full fertilizing power. —*B.I.S.*

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

DIEU
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Vol. IX : No. 3
MARCH 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.3.48
2,800

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertiscments should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department, (Publication Branch), India House, Aldwych, London, W.C.2.

PLATE 7

Hon'ble Shri Jairamdas Daulatram, Agriculture and Food Minister, Government of India, opening a two-day session of the Governing Body of the Indian Council of Agricultural Research in New Delhi on 29 January 1948.

INDIAN FARMING

MARCH, 1948

Vol. IX No. 3

PROBLEMS OF INDIAN AGRICULTURE*

IT gives me great pleasure to welcome you all here for this seventeenth meeting of the Governing Body of the Indian Council of Agricultural Research. It is the first meeting of the Governing Body after the attainment of Independence and the partition of the country. The changes necessitated in the constitution of the Council on this account have been approved at a Special General Meeting of the Council held recently and they have been brought into force with immediate effect. I take this opportunity of welcoming the representatives of the two newly created provinces of West Bengal and East Punjab and also the representative of Jaipur State which has joined the Council only recently.

I would first of all like to refer to the most important need of the country at the present moment, I mean the necessity of doing all we can to improve its food situation. We hardly realize the truth that probably no problem is more important for our country than that of food. It ought to be given the priority which is its due. Napoleon's dictum that 'the army marches on its belly' is as true to-day as it was a century and a half ago. We must make India self-sufficient in regard to food and that also soon. I wish the Centre and the provinces combined materially to increase the sowings of May and September 1948. The task before us is of a very emergent character and we require the active cooperation of every individual in the country in tackling this great problem. As you are all aware for several years now India has failed to produce the food it requires and the partition of the country has made the position worse. It is incumbent on the Council in common with other national organizations to do its utmost to bridge the gap by undertaking useful research for both short and long term plans and by transferring the practical results of such research to the farmer's field. I am gratified to find that this problem has already received the attention of the Advisory Board who have stressed the necessity of chalking out a programme of urgent research to help the campaign of food self-sufficiency. I am glad also that the necessity for having suitable legislation on certain important aspects of the problem has also been carefully considered by that body, and I hope the matter will be taken up in right earnest by all concerned.

One particular point I would like to mention in this connection is that with the exclusion of certain tracts from the Indian Union the situation regarding protective foods such as fruits and vegetables and fish has considerably deteriorated. I understand that the Indian Council of Agricultural Research is calling a Conference of Horticulturists some time in March next. I have no doubt that the conference will review the present position and suggest practical methods for meeting the shortage of fruits and vegetables in the Union. An urgent review of the position in respect of other articles of foodstuffs, e.g. fish, milk, potatoes, etc. will also be required. Several other nations do not consume *per capita* as much cereals as we do and yet have better physique and health. India's present shortage in regard to cereals could also be easily remedied if the nation altered its dietetic habits and consumed other foodstuffs. I hope that the Council will conduct a proper research into all these matters so as to make India self-sufficient in food.

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*Speech delivered by Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture at the opening of the Governing Body Meeting of the Indian Council of Agricultural Research at New Delhi, on 29 January 1948.

While research must be concentrated on the task of evolving better and higher yielding varieties of crops in discovering better cultural practices and in placing more efficient tools in the hands of the cultivators; while due attention must be paid to the improvement of the animal husbandry resources of the country and while, as I have already said, the highest priority should be given to the increase of the food supply of the country, attention must also be given to the eradication of pests and diseases of crops and cattle in order that the country may be saved from enormous losses of foodstuffs for which these are responsible. I am glad therefore to find that a serious attempt is going to be made to control the wheat rust and other pests which affect crops and animals. As regards wheat rust, the Central Government have set up a Committee to coordinate the work of control and the Government will finance the carrying out of this important work.

Survey and improvement of soils, production and use of manures and fertilizers and manurial and varietal trials as recommended in the extremely valuable report submitted by Dr Stewart have also to be undertaken. I am sure that if the experiments recommended in the report are conducted not only on individual cultivators' fields but also on an all-India basis they will yield valuable data regarding the optimum yields of crops.

As you are aware, there is a serious dearth of technical personnel in the country at the moment and the Government have taken upon itself the responsibility for sending men abroad for purposes of training. I hope that in the near future we shall have ample technical staff needed for our plans of progress. But even then the main problem will remain, viz. to link our existing man-power with the vast material resources of the country and to develop them according to a plan, for in planned scientific development only lies the salvation of the country. I am glad, therefore, to know that the Council has taken up the question of undertaking research on the basis of a planned programme from the Centre and on a regional basis. In framing our plans for agricultural progress we should work for a reasonable degree of regional self-sufficiency in regard to food. I have every hope that the provinces will give in this matter their fullest cooperation.

I think the Council was wise in amending its Charter to include developmental research and activities, for, in my opinion development cannot be divorced from research but must proceed hand in hand together. I shall be very much interested to know the results of the Delhi Development Scheme which the Council intends to work out. I understand that the intention is to apply all known improved practices in agriculture and animal husbandry in certain selected villages near about Delhi in order to prove to the cultivators what can be achieved by tackling their problems scientifically.

The economic aspect of the Council's researches should also be kept in view. As one of my predecessors had once said, a poor country like India can ill-afford 'Ivory Tower' research divorced from the realities of life and the needs of its cultivators. I welcome, therefore, the experiment that you propose to carry out regarding putting the 'cow on the plough'. Science must be utilized to serve the needs of the country but at the same time the economic aspect must not be overlooked. Agriculture being the most important industry in the country, the cost of production must play an important part in all the activities of the Council. I was interested to know that the Council had been carrying out crop-cutting experiments for some years now and that these experiments had been found to be very useful in estimating the crop yields in the provinces. Crop estimation is by far the most important aspect in the country's economy and I hope that the Union as a whole will adopt the technique in due course.

I regret to say, however, that one aspect of the Council's activities has not yet received the attention it deserves, that is its publicity and propaganda side. The Council must function effectively as the clearing house of information relating to agricultural and animal husbandry research and I would, therefore, suggest that its informational activities must be put on a satisfactory basis as early as possible.

The partition of the country has prejudically affected the financial resources of the Council and the income expected from the levy of a cess on agricultural produce is bound to fall in future. If the Council is to function satisfactorily it will be necessary for it to be provided with more funds than it can expect to get out of the cess. I hope that this body will make a strong representation to Government so that it may agree to make a suitable recurring grant to the Council for at least some years to come. I understand that the Advisory Board have recommended that the Government of India should be asked for necessary grants in connection with certain important activities, e.g. (a) carrying out of the agronomic and varietal trials recommended in Dr Stewart's report, (b) utilization of bone meals, (c) carrying out of research on tubers, etc. I think this is a step in the right direction and hope that the Government will come forward with liberal grants required for these and other purposes. It is impossible for this organization to serve the people of India unless its financial resources are very ample.

There are two other matters a reference to which is, I feel, called for in view of the circumstances existing in the country.

Heavy loss to food crops in India is being caused by insect pests and plant diseases, amounting roughly to about 500 crores of rupees. This damage is caused not only to crops when growing in the fields but also to grains after harvest and during storage, in fact till they are processed and consumed.

Several important authorities such as the Indian Famine Commission (1943), the Food and Agriculture Organization of the United Nations, have suggested very high priority to plant protection work in food production programmes and in fact the Council of the F.A.O. have expressed the opinion that this single factor, if properly attended to, can considerably reduce the food deficit of the world.

A good deal of the loss caused by pests and diseases can be avoided if control operations are taken in time and in a properly organized manner. It is therefore imperative that provinces should establish adequate Plant Protection Organizations for carrying out field scale control operations against more serious pests and diseases. The most essential pre-requisite for establishing such organizations is the appointment of well-qualified Entomologists and Mycologists at the provincial headquarters. At present only the three provinces of United Provinces, Bombay and Madras have such experts and these provinces are taking steps to establish Plant Protection Services for field work. The rest of the provinces, many of them are deficit, should emulate the examples of these provinces.

Control operations against some serious pests can be undertaken by simple methods, while others require power-operated sprayers and dusting machines which are unfortunately not so far available in India. Arrangements are being made for the import of a small number of such machines which after trial for a season or two will be selected as model for the manufacture, if possible, of such machinery on a large scale in India. As regards pests and diseases which can be controlled by other methods, the number of such enemies of food is also large, the Plant Protection Adviser to the Government of India is going round the provinces and suggesting in consultation with local experts what pests and diseases can be tackled immediately with the facilities available. It is hoped that during 1948 all provinces will endeavour to control these *saboteurs* of our food resources which are today inadequate for the needs of the country. The Plant Protection, Quarantine and Storage Organization of the Ministry of Agriculture will always be available for any assistance at the spot which the provinces may require. It need hardly be emphasized that the urgency of establishing provincial organizations is great.

The question of marketing of agricultural produce also needs attention. Though all provinces recognize the importance of improvements in Agricultural Marketing, of late there has been a tendency to side-track the subject and in some provinces the organization which had been set up to deal with the problem has been disbanded. In the East Punjab there has been a complete breakdown while in the United Provinces orders were recently issued to disband the office of the Chief Marketing Officer. Assam disbanded the Marketing Staff in April 1947.

In the majority of provinces the Marketing Staff was utilized for Civil Supplies work after the break of war and consequently there was a dislocation in marketing work. I would request all provincial governments to take stock of the existing agricultural marketing problems and immediately formulate and execute new schemes of marketing with special reference to cooperative marketing, regulation of weights and measures, organization of regulated markets and introduction of quality standards.

I do not wish to add to the length of my remarks at to-day's meeting by referring to other equally important matters. I would now invite you to take up the fairly long agenda which has been placed before the meeting.

Original Articles

DOUBLE CROPPING OF RICE AS A MEANS OF INCREASING PRODUCTION

By P. S. GUPTA and A. K. MITRA

IT was early in April, 1946, when the United Provinces was threatened with a serious shortage of food grains and the Government had already launched the emergency food production schemes to grow more food crops in the *zaid*, that the problem of taking two crops of rice from the same piece of land was taken up by us. Ramiah in his *Hand Book on Rice in Madras* reports that two crops of rice in the same season are taken in parts of Tinnevelly, Madura, Trichinopoly, Tanjore and Godavari districts. In the Godavari delta the first crop *sarva* is grown between June to November, and the second crop *dalva* between February and May. In the rest of the province generally a short-duration crop (July to September) is first grown followed by a long-duration crop (September to February).

As far as known to the authors the double cropping is not practised in the United Provinces to any appreciable extent because of low winter temperatures and weak north-east monsoon. Madras is differently placed with regard to both these factors. Advantage was taken of the fact that as a rule late varieties of paddy on the Rice Research Station, Nagina, were transplanted in the later half of July and being 'time fixed', i.e. maturing at a particular time of the year irrespective of the time of transplantation, they matured towards the end of November or early in December. So that even if transplantation of the late paddies was delayed to some extent, as a result of taking an early paddy in the same field, the maturity of the late varieties would not be affected and they will be ready for harvesting at the normal time. They will thus escape the rigours of the cold weather which might otherwise affect their growth and consequently the yield adversely. Besides this there was another facility which induced us to try out the experiment and this was adequate means of water supply at our disposal, both from the canal and the farm tube-well, which, it was thought, may turn out to be one of the most important factors in determining the success of the experiment when the temperatures were high, and low humidity and hot winds would demand frequent irrigations.

Materials and method

With the assured supply of water at our command, T.N.22, an early variety, was broadcast on 12 April, 1946, on a late paddy plot (0·99 acres). The seed rate given was one maund per acre. The crop was manured with castor cake at 40 lb. nitrogen per acre on 5 May, and was harvested on 21 July giving an yield of 17 maunds and 29 seers.

After the early paddy was havested, this plot was prepared in the ordinary way for transplantation of T.100, a late coarse variety. It was transplanted on 3 August. The plot was divided into two equal parts and one part was given castor cake at 65 lb. nitrogen per acre on 23 August and the other was left unmanured. Both were harvested on 30 November.

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Yield figures

The yield figures for early as well as late variety are given in Table I.

TABLE I

Yield figures of late and early varieties

Type	Yield per acre	
	Maunds	Seers
T.N.22 (Early)	17	37
T.100 (Unmanured)	22	0
T.100 (Manured)	28	16
T.N.22+T.100 (Unmanured)	39	37
T.N.22+T.100 (Manured)	46	13

From the yield figures given in Table I, it will be seen that an aggregate of 39 maunds 37 seers of paddy per acre was obtained by taking a late paddy crop without manuring after an early paddy crop from the same field, and an aggregate of 46 maunds 13 seers of paddy per acre was obtained under the same conditions except that late crop was manured at the rate of 65 lb. nitrogen per acre.

It might be pointed out here that the monsoon in this particular year was exceptionally favourable for the growth of late paddies and therefore a comparison of the yield of 'double cropped' T.100 with that of T.100 under bulk conditions on the farm for the year will throw light on the extent of depression that might be expected in the yield of 'double cropped' T.100. The yield of T.100 under manured condition (45 lb. nitrogen per acre) grown on one-acre field adjoining the 'double cropped' plot has been recored as 29 maunds and 21 seers. This compared very favourably with 28 maunds and 16 seers of 'double cropped' T.100 under manured conditions giving a deficit of only one maund and five seers, which is more than compensated by an additional yield of 17 maunds and 37 seers from the early variety.

Let us now consider the economics of this experiment to see whether the growing of an extra crop of an early variety compensates for the additional yield of paddy obtained by double cropping.

Economics of double cropping

The economics of the experiment are shown in Table II.

TABLE II

Economics of double cropping of rice

	Rs.	as.
1. Preparation of land including broadcasting charges	25	0
2. Cost of one maund of seed	14	0
3. Irrigation charges (canal) including labour charges	10	0
4. Castor cake 10 md. (40 lb. nitrogen) applied to early variety at Rs. 3-12 a maund	37	8
5. Extra manuring (20 lb. nitrogen) given to late variety	18	12
Total cultivation charges for early variety including extra manuring of late variety	105	4
6. Yield of early variety— 17 md. and 37 sr. per acre		
7. Less deficit due to double cropping over the normal yield—1 md. and 5 sr.		
8. Net gain—16 md. and 32 sr.		
9. Cost of 16 md. and 32 sr. at Rs. 14 a maund	235	3
10. Net profit	129	15

The cost of cultivation of late variety has been purposely excluded from the above economics as it would in any case be incurred in the ordinary way. The extra cost of manuring the late crop in double cropping (20 lb. nitrogen per acre) has been included, as T.100 under bulk condition was also manured with castor cake at 45 lb. nitrogen per acre.

It would therefore be seen that a net profit of Rs. 129-15 may be expected by double cropping of rice in the United Provinces given suitable conditions of manuring and irrigation.

Economic advantage

The facts given above go to show that not only does double cropping of rice lie within the realm of practical agriculture in increasing food production, when certain conditions are fulfilled, but also it offers an economic advantage to the rice grower. The additional quantity of rice obtained in double cropping is bound to go a long way in reinforcing the provincial granary at a time of acute shortage of food grains.

These results can find their application in places like Mirzapur and Banda where late varieties of paddy are predominantly grown under canal irrigation. Out of a total of 251,300 acres under paddy in Mirzapur, 191,270 acres are occupied by the late varieties of which 119,363 acres are irrigated. In Banda out of a total of 110,239 acres, late varieties are cropped on 63,291 acres of which 58,290 acres are irrigated.

In addition to these there are other districts which, though not predominantly late paddy districts, nevertheless claim large areas under late paddies irrigated by canals. Such districts are Dehra Dun, Saharanpur, Muzaffarnagar, Mainpuri, Shahjahanpur and Fatehpur which claim more than ten thousand acres each under irrigated late paddies.

In some scattered areas in the province the practice of sowing early paddy in the month of April, known as *chitwa*, is not altogether unknown. This practice may be extended to include late varieties in their cropping scheme.

Double cropping with early varieties

And finally it is considered that double cropping of rice with both the varieties early, one following the other, will not be so advantageous as the early varieties are 'period fixed', i.e. they require a particular period for maturity. If the sowing of the second early paddy is delayed in consequence of the delayed harvesting of the first early crop, the harvesting of the second crop will also be delayed. And since the time of sowing has a marked influence on the yield of the crop, the delayed sowing of the second early crop is likely to result in appreciably lower yields. Consequently the net gain that may be obtained by double cropping with both early varieties may not be of the same order as with one early and one late varieties.

'RICE' FROM WHEAT

ESTABLISHMENT in Western Australia of a process plant to make substitute rice from wheat, particularly from damaged wheat, is planned by Mr. E. Huzenlaub, an analytical chemist of Chicago, U.S.A.

Mr. Huzenlaub says that his process takes the peculiar aroma out of wheat and makes it into a grain that looks and tastes like rice. He hopes to turn out a high-grade grain suitable for export to eastern countries. The process machinery can, he says, be made in Perth factories.—*Agricultural Newsletter*, Release No. AGN/189.

A MULLET FARM IN COCHIN STATE*

By T. V. R. PILLAY

WHILE spending a part of my leave in my home town in Travancore last year during the month of March, I visited the Narackal Fish Farm in Cochin State. Again this year (June, 1947), when at Cochin, I spent some time at the Farm with a view to make a detailed study of its layout and cultural operations. The following account was written at the instance of Dr S. L. Hora, Director, Zoological Survey of India, to whom I am highly indebted for very useful comments and valuable suggestions. Acknowledgements are also due to Mr. S. P. Basu of the Bengal Fisheries Directorate for offering some comments on this note and to the Fishery Officers of Ernakulam and Narackal, especially my friend Mr. P. M. G. Menon, for their courtesy and help during my visits.

History of the farm

Naracka1 is an important fishing village lying about nine miles north of Cochin and forming a part of the narrow strip of land lying between the Cochin backwaters and the sea. This area abounds in extensive shallow swamps unsuited for agricultural purposes. In pursuance of the Government policy of converting 'poramboke' shallows into cultivable and fishable areas, a fish farm was opened here in 1939-40 in the vicinity of the Government Fish Curing Yard for the purpose of demonstrating how these watery wastes could be utilized for profitable fish culture. Sixteen acres of such 'poramboke', lying adjacent to the sandy beach and consisting mostly of a swamp about a foot deep and partly of shoals, were taken over by the Department of Fisheries. Construction of an embankment all round the swamp, and a general deepening of the same to convert it into ponds, were started in 1940-41 and completed in the following year. About 11 acres of securely enclosed area were thus made available for fish culture in 1941-42. 'A limited area of 75 cents was enclosed and deepened to a depth of 3½ ft. which was considered reasonable depth for some of the fishes for stocking experiment'[1]. 'Grey mullets of tender and middle-aged types were fished alive from the backwater near Ernakulam and Kadamakkudi with the help of expert fishermen in the month of *Chingam* and *Kanni* (August-September and September-October). Small consignments of them were transported in canoes half-filled with water or tubs with water placed in the canoes. The water was being constantly renewed in the course of transport. Many of the tender ones failed to survive transport. But with great care, with constant renewal of water, with shelter from the sun provided with wetted bamboo screens, the staff succeeded in stocking the pond with a few tender ones and a small number of mature fish'[2]. To prevent the great mortality that was caused during the height of summer due to rising temperature, deep water tracts were provided in some of the ponds in 1942-43. Since then, stocking has not been very regular, except during the last and the current years, when about 7,000 fry each were liberated into the Farm. Fishing and marketing were carried on from 1940-41 during the off-season, when good table fish are not available in the market.

Layout of the farm

The Farm consists of seven unequal ponds (Fig. 1) bounded by a strong earthen embankment 4 ft. high from the pond bed. The height of the embankment is the same as that of the neighbouring land, labelled 'coconut plantation' in the diagram. The bunding which is 12 ft. wide at the bottom and 6 ft. at the top, is reinforced by strong turfing. There are

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* Published with the kind permission of the Director of Fisheries, Baroda.

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[1] *Administration Report* of the Land Revenue Department in the Cochin State for the year 1116 (1940-41), p. 49

[2] *Administration Report* of the Land Revenue Department in the Cochin State for the year 1117 (1941-42), p. 24

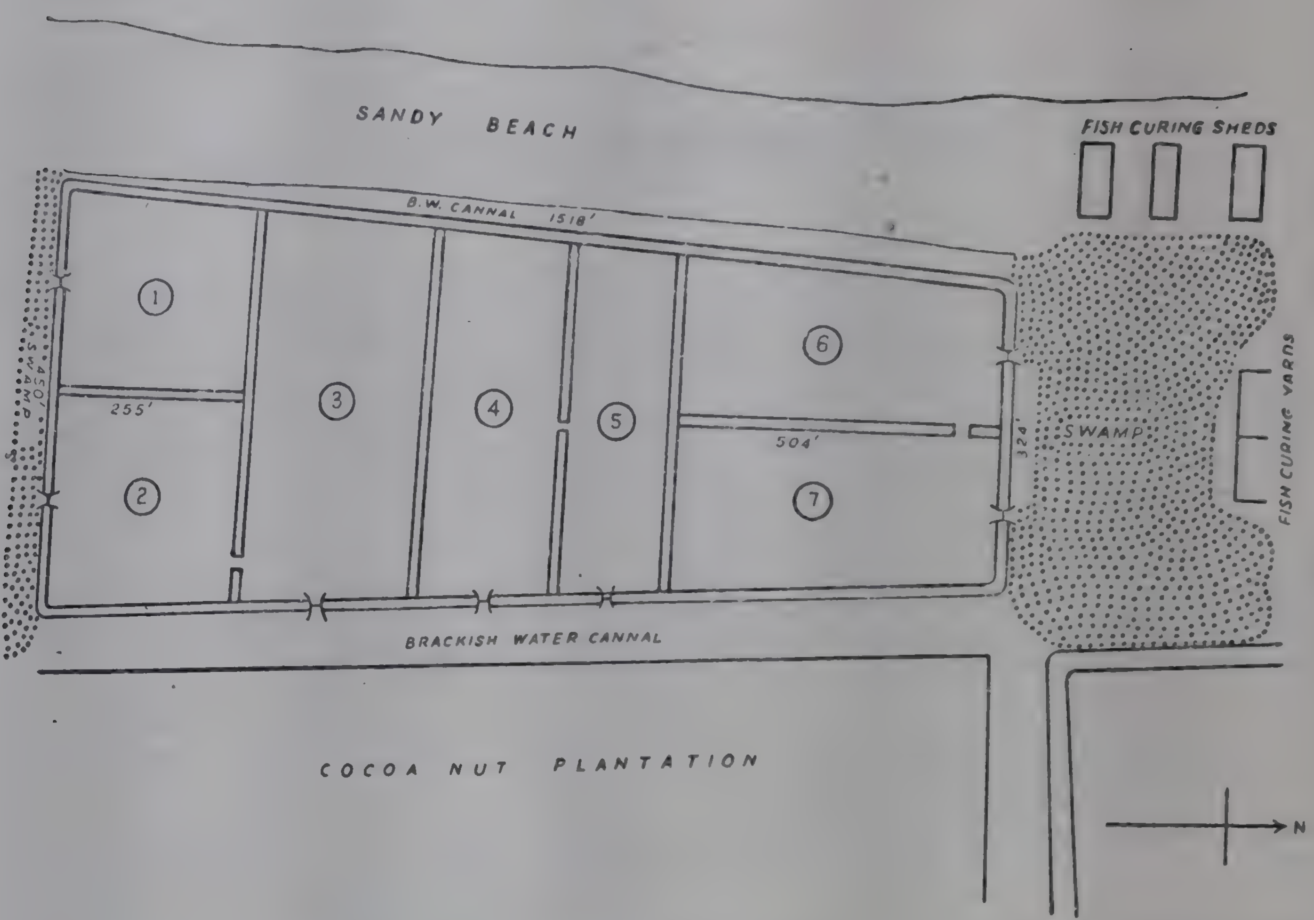

FIG. 1. Layout of the Farm.

brackish water canals on the east and west and swampy areas on the north and south of the Farm site. All the seven ponds are in communication with the canals or the swamp by means of gaps, 2½ ft. wide, on the embankments which are guarded by bamboo gratings. The interstices between the bamboo-splittings measure ¼ in. to ½ in. Recently some improvements have been effected in the arrangement of the sluices. The edges of each gap are now riveted with wooden planks, and kept in position by means of three wooden frame-works fitted inside. The middle frame has in it fitted the bamboo grating. This is meant to prevent the escape of fish from the Farm, as also to check the entry of grownups. The high tide freely flows in, flooding the Farm, and drains out through the sluices. The northern part of the Farm, deepened to about 3½ ft., holds two to three feet of water at low tides. But ponds numbered 1 and 2 are shallow and are almost completely exposed during low water, the maximum depth at high tide being only 2 to 3 ft. As the depth of the Farm was found insufficient for free movement of fish, deeper tracts were constructed in some of the ponds. Ponds numbered 3, 4 and 5 were provided with such sanctuaries, 150 ft. long, 25 ft. wide and 6, 3 and 4 ft. deep respectively. Ponds numbered 6 and 7 had similar tracts 3 ft. deep. But due to lack of adequate attention most of these areas have now got filled up.

Method of culture

The cultural operations here start with the stocking of fish fry at the beginning of the monsoons in May and June. At present the main collecting ground is the shallow swamp lying north of the Farm in front of the Fish Curing Yard. This area, where prawn and fish offal from the Yard are dumped daily, virtually swarmed with mullet fry at the time of my visit in June. They are collected by means of 'pattukanni' nets. It is a sort of rectangular pouch net, measuring about 40 ft. by 20 ft. and made of 20 counts cotton yarn. The size of the mesh gradually diminishes from one inch at the mouth to one-fourth at the posterior end. The net is set in shallow water with the mouth kept wide open by two fishermen standing at the two corners, holding it by means of the free loops of coir rope reinforcing the net margin. The upper margin is buoyed up by means of wooden floats tied 2 ft. apart, and the lower one kept down parallel to the bottom of the swamp by the fishermen standing on it. A long scare line, sometimes as long as 100 to 200 ft. made of coir rope, with tender leaves of the cocoanut palm strung all over, is operated in front of the net and fish from the three sides are driven towards it. As soon as the scare line is brought near the mouth, the purse is closed by bringing together the two margins. The net is then hauled up and all fry between 3 to 4 in. in size thus entrapped are gathered together in bamboo baskets. They are immediately transferred to the Farm. Incidentally it may also be stated that the Department of Fisheries is now declaring the operation of 'pattukanni' net by private fishermen illegal, as it results in the destruction of immense quantities of young fish.

Though the reports mention that grey mullets stocked belong to the species *Mugil cannesius* and *M. ocur*, the fish in the Farm now are mainly *M. cephalus* and *Chanos chanos*, the former forming more than 75 per cent of the catches. Other species occurring in the fishery are Etroplus *suratensis*, *E. maculatus*, *Lates calcarifer*, *Polynemus* sp., *Therapon jarbua* and *Serranus* sp. Though not deliberately stocked, prawns also enter the Farm when young, and grow in the safety of the confined area. The in-flowing tide brings with it a daily quota of fish food in the form of plankton, and the fishes in the Farm feed on this. The contents of *M. cephalus* showed a preponderance of algal filaments and sand grains, indicating strong browsing habits. During the height of summer, a recurring mortality is caused when the temperature of the Farm water goes abnormally high. Attempts to check this by inter-connecting the various ponds by means of gaps in the cross bunds have not always been very successful.

Results of mullet culture

It is indeed regrettable that no regular record of growth, habits, etc. of the fish have been kept by the Department so far. On June 21, 1947, when the ponds were netted, *M. cephalus* believed to be one year old measured 18 in. to 19 in. The local fishermen believe that the grey mullets leave the backwater for the sea during the spawning season. The Farm has served to provide some definite evidence against this theory. In 1941-42, it was reported: 'At present the little pond provides the engaging spectacle of mother fishes with a brood of fingerlings, squirming by the side of the sluice where the temperature of the water tends to go down as a result of the co-mingling of the less warm water from outside with the relatively warmer water of the inside of the pond during the high tide'[1]. Though this has not been conclusively proved, it appears quite probable as *M. cephalus* has been observed to breed in confined areas in Egypt[2]. Adults fished from the Farm in June were found to be in mature and oozing condition which also lend further proof to this observation.

The capital outlay on the Farm is reported to be Rs. 500 per acre, paid towards cost of the acquired swamp, and approximately Rs. 11,400 spent for the construction of embankments, deepening, etc. The annual maintenance charges are:

Pay and allowance of watchman @ Rs. 20+20 p.m.	..	Rs. 480
Lighting charges @ Rs. 2 p.m.	..	Rs. 24
Petty constructions and repairs	..	Rs. 200
Fishing (including stocking) charges @ 10 per cent of catches (approximately)	..	Rs. 400
Total	..	1,104

It is no mean achievement to have been able to place on the market, though only in limited quantities, one of the most relished food fishes of the locality during periods when they are not easily available otherwise. The official reports show only the annual income in terms of cash and not the poundage of fish or prawns produced. The catches are auctioned and sold to the highest bidder. The proceeds collected during three years are as follows:

1940–41	..	Rs. 376–13–0
1941–42	..	Rs. 198–11–0
1942–43	..	Rs. 271– 7–0

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[1] *Administration Report* of the Land Revenue Department in the Cochin State for the year 1117 (1941-42), p. 24

[2] S. L. Hora, (1944). Development of inland fisheries as a possible solution for meat shortage. *Science & Culture*, IX, p. 521

From last year, partly due to more regular stocking, and mainly due to the prevailing high prices of fish, the income has increased considerably. Last year (1945-46) about 9,000 lb. of fish were marketed from the Farm at an average price of eight annas per pound. The sale proceeds during 1946-47, till June, was Rs. 4,753-0-6, and at least Rs. 500 more are expected before the end of the year. Taking the average price to be eight annas per pound the production this year can be computed to be about 10,500 lb.

Present position of farm management

Although mullets, grey and white, form the favoured varieties for culture, other species are in no way precluded. *Serranus* sp. and *Lates calcarifer*, which are predacious in their habits, occur in the Farm and cause considerable loss. *Therapon jarbua*, locally known as *savamkothi* (corpse-pecker), is believed to cause the death of mullets by pecking and feeding on their eyes. A few dead specimens of *Chanos* were seen floating at the time of my visit with the eyes completely eaten off. However, the exact cause of death has yet to be verified. The uncontrolled flowing in and out of tidal water puts a premium on attempts at their eradication by occasional netting. Though adults cannot enter the Farm through the bamboo gratings, they gain easy access in the form of eggs or larvae. During the stocking operations also, fry of many undesirable species are liberated into the Farm unnoticed.

Another serious defect is the lack of an adequate depth of water for the comfortable life of fishes at low tides. The sanctuaries constructed five years ago do not exist any more, and as a result considerable mortality takes place due to the unbearable heat of the sun in the hot months.

The Farm is entirely dependent on the fluctuating quantities of fish food brought in by the tides. No attempts have so far been made to enhance the food supplies by artificial methods.

Perennial direct connection with the adjacent swamps and canals has a salutary effect. The salinity of the Farm is always maintained at the same level as that of the surrounding water sheets, so much so that the embankments are safe from possible damages caused by boring animals trying to escape from inside when the salinity increases, as observed in the *bheris* of Sunderbans.

As late as this year the Farm was left in charge of a staff with no scientific training, and so a lot of very useful data about the mullets and their culture, that could have been collected during these years, have been sadly lost to science. However, a trained officer has now been appointed to be in charge of the Farm and it is expected that this matter will be attended to in future.

Improvements suggested

An easy method of rectifying the two main defects of the farm, viz. its shallow nature and the presence of predacious fishes, is by effecting certain improvements in the construction of the sluice gates. Of the wooden frame works supporting the sluice rivetments, the first one from outside can be fitted with adjustable shutters. At high tide these shutters can be opened and before the turn of the tide closed down and adjusted to hold the required depth of water. This will ensure safety from the heat of the sun, more living space and increased food supplies to the fishes reared. Larger quantities of fry can then be stocked with advantage. Another possible improvement is the provision of fish traps (atols) behind the sluice as is done in the Bhasabhada Fisheries of Sunderbans[1]. The one-piece bamboo-grating-protection of the sluice should be replaced by two pieces set in the form of an inverted V, leaving a narrow gap at the apex. Behind this narrow passage should be fitted the trap or atol. By the force of the inrushing tidal water, the apex of the two bamboo 'pattas' will widen a little and the fishes brought in and led into the trap. At the end of the tide, the trap can be hauled up and thorough sorting of the catches made before liberating them into the Farm. This will exercise a very effective check on the entry of undesirable species and facilitate stocking operations.

Manuring and artificial feeding are bound to result in better production of fish. Mullets have been found to feed very well on rice bran. The soft portions of the fish offal from the Curing Yard can also be used for direct feeding. If the shutters are provided for the sluice as suggested above, fertilizing of the ponds will become possible. The refuse from the Fish Curing Yard now thrown into the swamp can profitably be dumped in suitable quantities in protected corners. But the pond water should not be allowed to flow out till the manure is completely used up. Chemical fertilizers may probably prove more efficient from the point of view of easier utilization.

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[1] S. L. Hora and K. K. Nair, (1944). Suggestions for the development of salt-water *bheris* or Bhasabhada Fisheries in the Sunderbans, p. 3

Being the first Farm of its kind in this part of the country, the establishment of a small laboratory nearby to study the hydro-biology of the ponds and the bionomics of the mullets is an obvious necessity.

HOW TO GROW MORE FOOD

IN a recent article Shrimati Mira Bahen has emphasized Mahatma Gandhi's viewpoint that it is possible to make up India's food deficit by our own efforts within the country, and that it is wrong for us to look to other countries for help. She says everyone can help, from the private individual to the huge Government machine. Her suggestions are : (1) People who have not even an inch of land can collect together old broken pots, pans and boxes, put a little earth in them, and raise salads and vegetables. (2) Owners of bungalows and houses can supply the city and town markets throughout India with green vegetables, roots, potatoes, pumpkins, marrows and the like, at reasonable rates. (3) Municipalities can augment this supply (adding grain crops where the land is sufficient), through the cultivation of public gardens, parks, etc. (4) Governments can aid villagers far more effectively than they are doing at present in the better development of already cultivated land.—*Food Bulletin*, November 17, 1947.

CONTAGIOUS ABORTION IN FARM ANIMALS

By P. R. NILAKANTAN

THIS disease together with tuberculosis, Johne's disease and mastitis constitutes a great hazard to the dairy industry in the various countries of the world. It is responsible for causing a great loss to the dairy farmers as, apart from producing the manifest effects such as death and abortion of the foetus, it reduces the milk yield of the aborting cows and ultimately renders them sterile and unproductive. The working bullocks are rendered unserviceable to a certain extent by joint affection by the same causative organism (*Brucella* sp.). The disease is also important from the public health point of view as people who are handling the infected animals or those who drink raw milk of infected animals are liable to get what is known as 'undulant fever' or 'Malta fever'.

Incidence

In India, the disease is common in areas with a heavy rainfall distributed throughout the greater part of the year and little sunshine. Conversely, it is less common in the areas of low rainfall and bright sunshine. Thus, the largest number of cases have been detected in Bengal, Assam, Orissa and the coastal tracts of Madras. It appears to be not so common on the Deccan plateau. Not only does it exist in well-managed and organized dairy farms such as those in the Punjab, the United Provinces, central and northern Bombay, but its occurrence has also been detected among village cattle in certain parts of Madras, Central Provinces, Orissa, Hyderabad and to a less extent in Mysore and southern parts of Bombay. It is more or less absent from Sind, Baluchistan, North-West Frontier Province, Rajputana and Ajmer. It has been estimated that the incidence of infection in the affected areas amounts to about 30 per cent and the abortion rate among the breeding stock about 10 per cent per annum. In infected farms in which animal husbandry practices are quite sound, the annual loss of calves due to this disease has been found to be only 1 to 3 per cent, while in badly managed farms the annual loss of calves may be as high as 25 per cent.

Cause

The causal agent of the disease is a bacterial germ known as *Brucella* which can be seen under the microscope as short and slender rods. The germ thrives well in insanitary conditions, in the absence of sunlight and in miosture.

Susceptibility

All the farm animals such as cattle, goats and sheep are liable to become infected. The pregnant animals are more susceptible than the non-pregnant ones, as in the former the causal agent finds a good medium for growth in the gravid uterus and brings about abortion. It has been observed in India that the cross-bred animals are more susceptible than the indigenous breeds of cattle. Immature animals are resistant to infection.

Mode of infection

The source of infection is a diseased animal which can transmit the disease to healthy stock by various means, the most common being the direct contact between the healthy animals and infectious discharges of the diseased ones. This mode of infection takes place when the feeding stuffs become contaminated with the vaginal secretions and urine of freshly aborted cows, or when the aborted foetus or the after-births are licked by the healthy animals. Similarly, the disease is conveyed by farm attendants who after handling an aborted cow attend to clean animals; flies also carry the infective materials from the infected animals to healthy ones. The bull can also carry the infection mechanically from the vagina of an infected cow to that of a healthy one when serving one after the other.

Nature of the disease

The only symptom shown by the infected animal is abortion. All infected animals may not abort, but those which acquire infection

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during pregnancy are sure to abort. Abortion may occur during any period of gestation but generally it is more common during fifth and sixth month of pregnancy. The majority of infected animals abort only once but, although they may in subsequent pregnancies give birth to normal calves, they are a great source of danger to the healthy animals as they will be disseminating the causative organisms with the milk, after-births and vaginal discharge after parturition. It has been observed that these animals are pre-eminently infectious for about three months after abortion during the first pregnancy. The danger continues during the succeeding parturitions to a lesser extent and becomes much more insignificant during the third or the fourth succeeding calving.

Diagnosis

The commonest method of diagnosis of *Brucella* infection is to put the blood serum of the suspected animal to a test known as 'agglutination test'. One test may not reveal all the infected animals in a herd; repeated tests are, therefore, indicated to spot out the infected animals. Diagnosis can also be made, where laboratory facilities are available, by the isolation of the causal agent from the heart blood and stomach contents of the aborted foetus or from the vaginal discharges and the milk of the animal itself. A veterinarian's help should be sought for this purpose.

Prevention and control

As there is no medicinal treatment of this disease, it is essential to concentrate attention on prevention and control of infection in a herd. In India, control by test and slaughter of the positive animals will not be feasible due to religious sentiments. The important means of control would, therefore, resolve into (i) measures of hygiene and (ii) vaccination.

Hygienic measures of control: For this purpose each farm should have separate maternity boxes or calving pens for the infected animals situated in one corner of the farm where the healthy animals will have no access. The *Brucella*-infected animals should be kept segregated in those boxes or pens as follows: (i) during the first infectious pregnancy, which usually ends in abortion, the animal should be kept segregated from the time when it shows first signs of abortion until three months after abortion, (ii) during the second infectious pregnancy it should be segregated four weeks before to six weeks after parturition, (iii) during the succeeding two pregnancies the desired period of segregation should include four weeks before and ten days after parturition or until such time as the vaginal discharges have ceased, and (iv) for further pregnancies it would suffice to take ordinary precautions at calving.

The aborted foetus and the after-births should be carefully burnt and the place where abortion had occurred should be thoroughly disinfected.

It is essential to keep the animals under clean surroundings. The vaginas of the infected animals should be douched with antiseptic lotions once or twice a week for about four to six weeks after abortion or the termination of pregnancy. For douching a freshly prepared chlorinated solution (bleaching powder 25 grams, boric acid 25 grams, and two litres of boiled water) has been found to be very satisfactory. As an alternative, potassium permanganate solution (one part in 500 parts of water) or common salt solution (two table spoonsful to a gallon of water) can be used.

Care should also be taken to prevent the spread of infection through the bulls. If possible, a separate bull may be used to serve the infected cows or else such cows should not be served during the period when they are kept segregated. The sheath of the bull should be washed soon after serving an infected cow. These difficulties can be overcome by the proper application of artificial insemination where facilities are available.

In farms where valuable animals are kept and where there are only a few cases of this disease, it is advisable to blood-test all the healthy animals during the fourth and the fifth month of gestation and segregate the positive ones. The healthy cows in a herd should also be tested after parturition and in case some of them are found infected they should be segregated for enforcing the measures of hygiene indicated above.

It is not necessary to take any special precautions for the calves born to infected cows except that they are to be kept away from their dams during the period when the latter are kept segregated.

Control by vaccination: Vaccination against brucellosis is becoming popular in the western countries. It is of great help in farms with a heavy infection and where due to climatic conditions the hygienic precautions stated above cannot be enforced properly. The vaccine used is a saline suspension of a mild strain of live *Brucella abortus* which is capable of producing immunity in the inoculated animals. Usually calves between four and eight months of age are vaccinated and the immunity produced in them is supposed to last throughout their life time. In badly infected herds the vaccine can be used with beneficial results to the non-pregnant adult cows also. The dose of the vaccine is 5 cc. per animal to be injected under the skin. The vaccine produces a mild rise in temperature and a slightly painful and hard swelling at the seat of inoculation two to three days after vaccination which subsides in about five to seven days. No special care need be taken of the vaccinated animals. The vaccine is however to be used with caution under the direction of a competent veterinarian because of the possibilities of producing a carrier of the disease.

PRINCIPAL CAUSES OF FIRES ON FARMS

OF the 8,000 farm fires estimated by the Dominion Bureau of Statistics to have occurred in the 12 months ended June, 1947, about 3,000 originated in the farm house, 3,600 in barns and outbuildings, and the exact place of origin of 1,400 could not be determined.

Defective chimneys and flues were the principal cause of house fires, and sparks on combustible roofs caused 400 fires to farm homes and 200 to barns and outbuildings. Overheated stoves and other heating and cooking equipment was a common cause of fires not only in the home but in barns and farm buildings. Brooder houses and tobacco kilns were frequently damaged or destroyed by faulty heating devices.

Farms, many of which lack electricity for lighting, are more subject to fires arising from overturned lamps and storm lanterns than other households. It is estimated that the use of inflammable liquids such as coal oil and gasoline caused 900 fires, 200 more than those started by lightning.

Thirty-five per cent of the fires arose from unknown causes, but past experience would suggest that a large proportion of these arose from spontaneous ignition, particularly in overheated hay and grain.—*Dominion Department of Agriculture*, Canada, December 24, 1947.

VIRUSES AND COMMON VIRUS DISEASES OF DOMESTIC ANIMALS

By C. SEETHARAMAN and G. L. SHARMA

PARASITES causing diseases in man or animals may be as large in size as worm in the intestine or lice or ticks on the skin, while diseases like cholera, tuberculosis, malaria and typhoid, etc. are due to organisms which can be seen only under the microscope. There is yet another set of diseases produced by living entities so minute in size that most of them are beyond the range of visibility under the microscope. These are called 'viruses' and the diseases produced by them 'virus diseases'. In this article are described some of the more important virus diseases of Indian domestic animals.

Virus defined

Before describing virus diseases, it would perhaps be better to mention what viruses are and how they differ from other microbes which can be detected under the microscope, viz. bacteria, protozoa and fungi, etc. Viruses, also known as 'ultramicroscopic microbes', because of their invisibility even with the aid of the most powerful microscope, can be filtered through certain porcelain or earthenware filters through which even small bacteria cannot pass. Further, viruses cannot be cultivated on inanimate nutrients on which bacteria can grow and multiply. Living tissue is a necessity for the propagation of viruses and it may be added that some of the viruses have been grown on living chick embryos, e.g. Ranikhet disease virus, pox virus, rinderpest virus, etc. Besides these there are other minor differential points. Virus diseases are highly contagious and spread rapidly. Survivors from an outbreak acquire resistance to the disease and this resistance, known as 'immunity', may be life-long as in pox or rinderpest. Similar resistance can be conferred in animals by artificial means. The animals get mild attack of the disease, recover and thereby acquire an immunity against it.

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The more common virus diseases of domestic animals in India are rinderpest, foot-and-mouth, pox-group diseases, rabies, canine distemper and Ranikhet disease of chickens. They are briefly described here so that the livestock owner may have a general idea about them and thus be better able to cooperate in attempts towards their control and prevention.

Rinderpest

Rinderpest is an acute infectious and contagious disease of the cud-chewing animals, e.g. cattle, buffaloes, goats, sheep, etc. The main symptoms are that the animal is dull, depressed, does not take its feed and has fever. Later, vesicles appear on the lining of the gums, tongue and lips, which subsequently burst to produce ulcers. Diarrhoea follows and the animal becomes extremely weak and succumbs in about ten days after the onset of symptoms. Rinderpest easily spreads from one animal to another mainly through attendants. Different breeds of cattle behave differently in their susceptibility to the disease, e.g. hill cattle are more susceptible than those of the plains. In general death rate varies from 20 to 80 per cent.

Medicinal treatment is of no avail in combating rinderpest; neither it is economical when dealing with a large number of animals. As a preventive measure, cattle of more than six months of age can be advantageously protected by vaccinating them with 'goat-tissue-vaccine'. The vaccination can be arranged through the local veterinary surgeon.

Foot-and-mouth disease

Foot-and-mouth disease is an acute contagious disease of cattle, buffaloes, sheep, goats and swine. Human beings are susceptible but to a very low degree. Animals get infected by contaminated fodder, water and through attendants. In the early stages of the disease the animal is dull and shows a rise in temperature. This is followed by split-pea size vesicles on the tongue, lips and on the clefts of the feet.

The animal is seen shaking the affected limb frequently. There is excessive salivation which is stringy.

Though not many animals die during the course of this disease, it is of great economic importance because there is a marked decrease in the milk yield of affected cows, draught animals cannot be put to work due to painful condition of the feet and lastly but not the least in importance is the loss in the general condition, viz. starring coat, deformed feet, and difficulty in breathing, technically called 'panting', which is very much marked during the summer. An outbreak lasts for about two weeks but this period can be cut short by rubbing the saliva from mild cases of the disease on the mouth of other susceptibles on the farm so as to carry the disease through a shorter period as normally it takes a long time for spread and recovery. Milk from affected animals should be boiled before it is consumed.

Symptomatic treatment like washing the mouth with mild antiseptics, e.g. potassium permanganate 1 in 1,000 solution or a 3 per cent alum solution, and dressing the feet with a mixture of coal tar and copper sulphate to prevent maggot formation in the clefts combined with hygienic measures are very useful. Attempts to prepare a vaccine against this disease are in progress at the Indian Veterinary Research Institute, Mukteswar.

Dermatitis or pox-like diseases of goats and sheep

Goat and sheep dermatitis are newly recorded virus diseases and have been frequently confused with pox. Onset of the diseases is manifested by general malaise accompanied by high fever and rough starring coat. The skin on examination is found to be studded with numerous elevated, raised, reddened areas all over the body. These raised areas later develop into nodules of rubber-like consistency but do not form into vesicles or pustules as in the case of pox. The nodules are seen on the lips, gums, tongue, abdomen, etc. Lungs are invariably affected with nasal discharge accompanied by difficulty in breathing. The affected animals die in about a fortnight. Attempts to immunize animals by scarification on the inside of the ear with a suspension of the nodules has given very good results.

Rabies

Rabies is an acute contagious disease generally of carnivorous (flesh eating) animals like dogs, cats, etc. and is transmissible to domestic animals and man by the bite of affected animals. After the bite fifteen days to six months may elapse before the symptoms appear. The animal is excited; it runs about and attacks any object which comes in its way. It may eat foreign bodies like straw, feathers, chips of wood, etc. There is dribbling of saliva. Subsequently paralysis sets in affecting the hind legs, throat, lower jaw and later the whole body. Death occurs in about ten days.

Those bitten by rabid animals or animals suspected for rabies can be protected by an efficient vaccine which can also be used as a prophylactic.

Canine distemper

Distemper disease of dogs is a specific contagious disease particularly of young dogs. The dog shows rise in temperature, is dull and off-feed. Sometimes the breath is offensive and there is digestive trouble and diarrhoea may set in. If the respiratory system is affected, there is a husky cough, discharge from the nose and difficulty in respiration. Frequently the nervous system is involved and the animal gets alternate attacks of excitement and depression. There are convulsions of the muscles of the head and neck. In later stages of the disease there may be weakness followed by paralysis of the limbs. Death rate among young and finely bred dogs is much more than in adults and may be about 30 to 50 per cent. Treatment in the initial stages is of much value. The proprietory preparations of Burrough's Wellcome Laboratories and Parke Davies & Company can advantageously be used in the control of the disease.

Ranikhet disease

Ranikhet disease is an acute, febrile, highly contagious and infectious disease of fowls, second to none in importance in this country. It is a great menace to the poultry industry because of its wide distribution with a mortality of 80 to 90 per cent. The main symptoms of the disease are that some birds show dullness and do not take their food. In a day or two there is diarrhoea. Often some birds show respiratory distress, weakness on the legs, later paralysis and death in about 2 to 5 days from the onset of symptoms.

The need for a vaccine as a prophylactic measure has been keenly felt by the poultry farmer. In its absence much attention was devoted to treatment and prevention by quarantine and other hygienic measures but the results were disappointing and the disease remained a stumbling block in the development of poultry industry until 1944. After an extensive study of the problem of immunizing birds against it, a vaccine has been successfully evolved at the Indian Veterinary Research Institute, Mukteswar. The vaccine is very sensitive to fluctuations of air temperature and must always be stored on ice. Chickens in good condition but not less than six weeks of age are vaccinated. After vaccination they may show drowsiness from the third to sixth day. Later, 1 to 3 per cent may become severely lame ; birds not improving within the following 3 to 5 days can be disposed of for table purposes. Egg production may also decline but will return to normal in about 14 to 21 days. Birds are immune in about two days after vaccination and the immunity induced is serviceable and enduring up to nearly two and a half years. Owing to the unavoidable difficulties in the transport of this vaccine, sub-stations for its manufacture have been established at Madras, Calcutta and Bangalore. Attempts to evolve easier methods of transporting the vaccine so as to make it available for the poultry farmer in the remotest village are in progress at the Institute.

ERRATUM

Indian Farming, Vol. VII, No. 12, December 1946, page 590, *What would you like to know ?*

Q. line 3
For Eichhorria Crassipes read Eichhornia Crassipes

A. line 6
For Eichhorria
read Eichhornia

THE DECCAN TRAP REGION: POSSIBILITIES OF DEVELOPMENT

By N. G. APTE

THE Deccan Trap region extends between latitude 15·5°N. to 21·5°N. and longitude 73°F. to 79°F. and occupies an area of roughly 140,000 square miles. The region is more or less triangular in form and covers about 28 districts from Bombay Province, the Central Provinces and Berar and Marathwada of the Nizam's Dominion. The chief characteristic of the region is that it is formed of a homogeneous mass of rock spread out in layers from 2 ft. to 60 ft. in thickness. The average thickness is about 25 ft. Each layer is usually cracked along the line of flow of the original mass. Geologists believe that large fissures several miles deep opened out thousands of years ago and lava flows came along and spread at long and irregular intervals, each flow cracking along the flow-line as it cooled. At times the top surfaces of certain layers were decomposed and remained as such when the next flow came along and spread over it. The total depth of this type of formation is estimated to be about 10,000 ft. At the centre of the fissure the lava set in as the hardest rock getting softer and softer as one moves towards the fringe. Thus in the Sanhyadris, the present high levels—the centres of fissures—are the hardest. There is no doubt that the whole region was a volcanic area at one time.

Topography of the region

The region has two main mountain ranges. One, the Sanhyadris, extend from south to north up to the Tapti river with three spurs stretching south-east and containing the valleys of the Krishna, the Nira, the Bhima and the Godavari. The other, the Satpudas, extend west-east from Shahada to Nagpur and beyond. The Sanhyadris superimpose laterite as they reach the limits of the Bombay Province and then superimpose granite further down. The process is so gradual that it is difficult to demarcate the exact place where trap ends and granite begins. The same is the case with the Satpudas. The relative high levels are seen beyond the Tapti and these extend eastwards fusing with the plateau of Nagpur and Berar beyond which is found either granite or rocks of the transition period. The general slope of the region is south-east due to the existence of these two big mountain ranges on the western and northern boundaries.

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The altitude of the region varies from sea-level to 45,000 ft. The maximum altitude is reached in peaks at Mahabaleswar, Pratabgad and some other peaks of the Sanhyadris. The Satpudas are a little less lofty. About 10 per cent of the region is occupied by these hills and their slopes, about 50 per cent is occupied by areas with heights of 2,000 ft. above sea-level or a little more; about 25 per cent by land with heights ranging between 1,000 and 2,000 ft. above sea-level, and the remaining 15 per cent by land below 1,000 ft. The plateau, about 2,000 ft. above sea-level, forms bulk of the region. Altitude is an important factor in determining the nature of crops that can be grown in the region.

Rainfall

Another important factor is rainfall which ranges from 10 in. to about 250 in. The region has about six clearly marked rainfall zones. Along the sea coast the rainfall towards the south is the highest and comes down to about 150 in. as one travels northwards to Bhatkal. It gradually decreases to 100 in. at Daman. These averages continue up to 50 miles to the east of the coast line. Immediately the central range of the Sanhyadris end, the rainfall falls down to 50 in. and goes on decreasing rapidly losing an inch per mile beyond the main range of the Sanhyadris till it averages only 10 in. This average continues up to 175 miles east from the sea coast. Thereafter the rate increases till it reaches 35 in. at Nagpur and 100 in. towards Waniganga. The period of precipitation varies from zone to zone.

In certain areas along the Sanhyadris the major precipitation is brought about by the south-east monsoon. While towards the Nagpur side the precipitation occurs at the time of both the monsoons. This difference influences cropping practices. All rain-fed crops are affected by the precipitation they receive as their growth is dependent on the available soil moisture. Cotton cannot be grown in a region where rainfall is expected during the harvesting time.

Temperature

Temperature is another factor that should be considered. Along the sea coast the highest temperature is in the neighbourhood of 100°F. and the range of variation is limited. Temperature steadily rises and the difference between the minimum and the maximum gradually widens as we travel inwards, till at Nagpur, the highest temperature is 118°F. and the lowest 40°F. or even lower. In the drier zones the temperature does not reach the lower limits while in regions with bountiful rainfall the lowest temperature falls below these limits indicating the possibilities of frost. This factor has a great effect on certain types of crops, specially sugarcane. The crops that need a comparatively greater assimilation of sugar require a high temperature and a low range of variation. The development of the sugar industry in the drier zones of Bombay Province is mainly due to this favourable temperature range and the availability of canal water. The development of fruit gardens in this very area is also to be traced to this cause as fruit plants have to synthesize large quantities of sugar for the proper development and ripening of fruits. Thus these plantations and orchards have developed in the drier tracts or low rainfall areas of the Bombay Province. Sugar industry and fruit growing are the best suited to this area. If there is proper coordination, this climatic condition would lead to the development of fruit preservation industry on a large scale. The particularly humid and extreme climate of Nagpur has developed a kind of citrus fruit which is peculiar to that locality.

Humidity therefore is another factor that counts. It is, however, not an independent factor by itself, since it is controlled by rainfall and temperature. The trap region can be divided into five zones from the point of view of humidity.

These generalizations about rainfall, temperature, etc. are modified by other factors such as occurrence of rivers, big tanks, etc. The changes brought about by these extraneous factors would have only a local effect. River valleys have their own effect on winds and consequently on precipitation. These factors however cannot be considered as important unless they have a substantial effect on the overall conditions. A vast irrigated area raises the local humidity permanently and influences the choice of a crop. It may also change the wind currents of adjoining localities.

The next important factor is the source of water supply for it decides the density and location of population that the region will have. This also decides the type of crops that the region will grow. If a flow of water is not available throughout the year, the nature of the population will be migratory. A permanent flow will have a permanent population round it and also allow crops to be grown for a longer period.

Underground water

The area irrigated by impounding underground water cover about one million acres in this region, whereas the area under other types of irrigation is barely a quarter million acres. If the underground source is properly and scientifically tapped, there is a possibility of irrigating another million acres and of producing one million tons of cereals and two and a half million tons of fodder for cattle. Thus, in addition to wiping out the shortage of 79,000 tons of cereals for the whole of the region, proper tapping of underground water can also help in meeting the deficits of adjoining areas.

It would be evident from the underground structure of this region that one has to tap either a crack or a fissure or a decomposed layer of rock in between two hard layers to find water. It is therefore essential that a scientific study is made of the structure of the region first and thereafter proper sites selected for tapping water. An ill-conceived plan in this matter is likely to lead to failure and waste of money and energy.

River water

The main flows in the region are the Narbada, the Tapti, the Godavari, the Manjara, the Prawara, the Bhima, the Sina, the Nira, the

Krishna, the Ghataprabha, the Penganga, the Wardha and the Veniganga. Of these the Narbada, the Tapti, the Godavari, the Bhima, the Nira, the Krishna and the Veniganga are the most important. They have a very large catchment and have very enormous flows. Only the Narbada, the Tapti, the Godavari and the Krishna reach the sea, the others joining these. The first two fall into the Arabian Sea on the west while the remaining two into the Indian Ocean. The following rivers flow out of this region : the Narbada, the Tapti, the Veniganga, the Wardha, the Godavari, the Manjara, the Sina and the Krishna. These are perennial rivers and, on a rough estimate, each river gives a discharge of at least 2,000 cubic feet of water per minute while leaving the region. Taking the average speed of water at 2½ miles per hour, the quantity of water flowing every day through these eight rivers, apart from the rainy season, would come to about 30,000 million gallons per day. This quantity of water is enough to irrigate about 750,000 acres per day. Taking an average rotation of about eight days required in the critical period, this water may irrigate about six million acres in this region. To save this quantity of water and to harness it for the purpose of irrigation may seem to be a tremendous job but, if managed on proper lines, this enormous quantity of water may be put to very good use. There is a great scope for development, for besides irrigating a vast area, it will generate millions of volts of electric power which can be put to use in agriculture and industry. The total area that may be brought under irrigation by the rivers and well water would, on a rough estimate, work out to about seven million acres, yielding about seven million tons of food grains and about 17 to 18 million tons of fodder.

The impounding of rain water would add another million acres to the area under irrigation. The total area of the region is about 86 million acres. This means that about 10 per cent of the total land area of the region can be brought under irrigation in addition to the present irrigated area.

A greater facility for irrigation will not only produce more grain but is also likely to supplement shortage of rain. This may help many crops like turmeric, ginger and cotton to be produced in this region. The long felt need of long staple cotton is likely to be fulfilled. Crops likes sugarcane, which can grow best in the tropical climate, will have greater field for expansion and this region would be able to solve the problem of sugar for local consumption. Fruit plantations can grow and may help in developing fruit preservation industry, specially if sugar can be easily obtained. The climate of this region is specially suited for fruit growing and at present there are about twenty different types of fruits with varying contents of sugars and acids as also of starch and proteins.

Construction of dams

Construction of big dams along the courses of the rivers will help to impound water and to divert the same into storages in dry areas such as the Desh. Most of the rivers have their sources high up at a level of at least 25,000 ft. and have considerable amounts of rainfall at their source. They fall down to about 1,500 ft. when they come to the plateau. This fall of about 1,000 ft. can be taken advantage of and at least 50 bunds, each 20 ft. high, could be put up ; the huge quantities of flood waters could thus be diverted to dry areas and the existing tanks filled in. This is a possible development with far-reaching effects, though the project is no doubt difficult to undertake. If a quantity of water, say about 150 in., falling over an area of 400 miles by 50 miles is collected into tanks, the total quantity thus collected would be 43 million gallons capable of irrigating 36 million acres for the whole of the year. Water collected from areas with even lesser amounts of rainfall can also irrigate another 36 million acres. Wells and tanks can also irrigate a considerable area. If a well-planned irrigation scheme is worked out, practically the whole of the region can be irrigated.

Water power

The water power would be utilized for generating electricity which in its turn would provide enough power for such industries as could be located in the region. Turbines could be set up creating an incentive to manufacture materials required to carry the current so generated. Electric motor industry could also be set up with little difficulty. Impounding of water would produce not only enough food but also enough power for industries. The present barrenness would be changed into productiveness and a new era of all-round economic prosperity, hitherto unknown to the inhabitants of the region, would be ushered into existence.

A CAMPAIGN ON NENDRUM PLANTAIN CULTIVATION IN COCHIN

By C. S. VENKITASUBBAN

IN Cochin few fruits are held in such high esteem as the Nendrum variety of banana—*Musa sapientum*. This variety is mainly cultivated on the west-coast tracts of Malabar, Travancore and Cochin—known collectively as Kerala—in South India, and the cultivation is at least as old as the Onam Festival which has been the most important national celebration of the Keralites from very early times. The Nendrum fruit is the most favoured of all articles in feasts connected with the celebrations, so much so, that it can be stated without exaggeration that Onam is not possible without Nendrum. The plant is also known as *Onam Vazha* in the local dialect and is to be found during Onam in each and every house of a Malayalee whether rich or poor.

Variety of uses

It is no wonder that the fruit claims such high esteem, because it is hard to find in the vegetable kingdom another fruit which admits of such varied and tasty preparations as this Nendrum plantain. The unripe fruit can be made into a variety of salted dishes; even the peel can yield tasty preparations. The fruits when sliced into thin discs and fried in oil make crisp and tasty banana biscuits; these may be sweetened, if so desired, by mixing with syrup. The ripe fruit can be made into very delicious confections and puddings. The fruit can be eaten by young and old with benefit. It is also a good baby food. The unripe fruits are sliced, dried in the sun and powdered into banana flour. This powder alone or mixed with an equal proportion of dried chips of the elephant foot yam—*Amorphophallus campanulatus*—is considered by the local physicians as the best food for babies. In the supply of vegetables and fruits to the civil hospitals in the State, Nendrum forms an important item, because it is considered to be suitable for patients. The ripe fruit sliced and dried in the sun can be preserved as banana figs.

The importance of these fruits increased manifold during the last World War. The State is dependent in normal times on external supplies of cereals, pulses, cows and buffaloes for her requirements of food. With the restrictions imposed by war conditions, a large proportion of these supplies was suddenly cut off and the State had to depend for food on her own resources. The cereal deficiency was counter-balanced by the production of the tuber, tapioca. Efforts to off-set protein and mineral deficiencies centred largely on the production of more vegetables, and the extension of Nendrum cultivation formed one of the major items.

Cultivation of the fruit

The crop is generally cultivated in single crop paddy lands but garden lands possessing a good soil are also suitable. The choice of a site is mainly determined by the availability of sufficient water for irrigation during the dry months and an easily drained soil. Another local name for the fruit, *Etha Kaya*, (*Etha* indicates a sort of lift irrigation) denotes the importance of irrigation for its cultivation. The crop is very susceptible to stagnation of water during the rains and hence soils subject to this defect have to be scrupulously avoided.

The raising of a Nendrum crop forms one of the main side activities of paddy cultivators, and tenants are induced to cultivate it by the landlords. In the lease deeds executed by the former is invariably inserted a clause to the effect that on the occasion of Onam one good bunch of Nendrum plantain must be presented to the latter. A landlord having a large number of tenants thus becomes entitled to many such bunches. The tenants vie with one another in presenting the biggest and most attractive bunch of fruit, and thus an impetus to better cultivation is provided. Several varieties of the fruit are cultivated.

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of Madras Presidency. The South Indian Railway had provided special concession rates for the transport. Since the outbreak of war, the cultivation has been steadily expanding, so that the present area might easily be double of what it was in the pre-war-days. The export of Nendrum bananas has been banned, except under permits issued by the Food Supplies Department.

Nendrum bananas are now much more common in the State coffee clubs and hotels, than preparations made of rice, wheat or pulses. In many a club, it is the only eatable available for tiffin.

SCIENTISTS HELP U.S. FARMS FEED MORE PERSONS

THE vital importance of continued advances in agricultural science is seen in the fact that each three acres of cropland in the United States must produce not only enough for one American but also an additional amount to help relieve hunger abroad.

This point was made recently by United States Secretary of Agriculture, Clinton P. Anderson, who noted that, if the United States population continues to grow as expected, the *per capita* share of farmland will be reduced to about 2·75 acres by 1970. This compares with an average of about four acres per person in 1918. And, he added, there is very little more of American land that can be brought into use through drainage and irrigation.

Thus, the work being done by American scientists, not only to preserve the present high standard of living but to improve it, has assumed the utmost importance. Among the advances and projects outlined by Anderson is that of increasingly better crop and livestock production, including the use of more hybrids. American plant explorers, after a wartime lapse, are searching the world for new plants.

Plant breeders now are using a discovery so new that they have only begun to see its possibilities. By applying to certain plants a drug commonly used to treat gout in humans they can produce larger and finer specimens and hybrids than would otherwise be possible.

Other advances listed by Anderson : new machinery that saves labour or does better work (already the average United States farm worker turns out nearly two-thirds more than he did 20 years ago) ; powerful new chemical insect killers ; improved soil conservation measures ; expanded knowledge of food nutrition ; better methods of distribution to cut waste and cost.—*USIS*.

POSSIBILITIES OF CULTURING THE *NAGENDRAM* FISH

THE *Nagendram, Osteochilus (Osteochilichthys) thomassi**, is one of the valuable commercial fishes of the Thungabadra River. Its fishery lasts from June to November when it is caught in considerable numbers. So far as I am aware, very little information is available about its bionomics and life-history. Though the species is common in the Ceded Districts of Madras, occasional specimens occurred in catches made in the Godavari and Krishna rivers. The observations recorded here were made at Sunkesula and on specimens taken from here to Nellore.

Mr. P. I. Chacks very kindly identified for me the gut-contents of 50 specimens from 9 to 15 inches in length and found filamentous algae, such as *Ulothrix* and *Schizomeria*, and diatoms of the genera *Navicula, Nitzschia, Stauroneis, Pinnularia, Fragillaria* and *Pocardium.* Sand grains were also sometimes found in the gut showing bottom-feeding habit.

The females become sexually mature when about 9 in. in length ; some of them were found to contain about 30,000 eggs. In the last week of June, the length of fry was about three-quarters of an inch but by October they had attained a size of 3 to 4 in. indicating a growth of approximately an inch a month. Fish reared in the Sunkesula Fish Farm attained a size of nine inches in the first year. It may, therefore, be presumed that maturity is attained within a year.

It has been observed that fingerlings stand transport well and it was possible to stock several pools of water in the Kurnool District with fry obtained from the Thungabadra and Kurnool-Cuddapah Canal. In nature, the average size to which this fish grows is one foot three inches with a weight of 1½ lb. but specimens up to 1 ft. 9 in. have sometimes been captured. Although the *Nagendram* does not grow to as large a size as most of the culturable carps, such as *Labeo rohita, Catla catla, Cirrhina mrigala*, etc. it is prolific, a vegetable-feeder, hardy and palatable. From the observations made at the Sunkesula Fish Farm, it appears that it can be subjected to cultural operations with considerable success. The fish has not so far bred in confined waters but its rich seed resources in the Thungabadra can be exploited with advantage till such time as its life-history and bionomics are worked out. My experience of handling this species has shown that it can be successfully adapted for cultural purposes[1]. (V. D. Spurgeon.)

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* I am indebted to the Zoological Survey of India for the identification of the species.

[1] My thanks are due to Dr T. J. Job for going through the note and to the Director of Industries and Commerce, Madras, for giving permission to publish the note.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. May I know if the river beds are suitable for the cultivation of potatoes?—(C.G.)

A. The river beds are generally sandy and the sandy soils are poor in fertility. Naturally such sandy soils are not suitable for potato cultivation unless manured very heavily. It may, however, be mentioned that cultivation of potatoes on river silt is being profitably practised in certain regions of South India. Also in Tonk State along the beds of the Banas river (which carries with it large quantities of silt during rainy season) extensive areas are utilized for potato cultivation in winter and good crops of potato are being raised year after year. It would be worthwhile therefore to chemically examine the sandy soil along the river beds for ascertaining its fertility suitable for potato cultivation.

Usually potatoes are grown in the river beds after the application of heavy dose of farmyard manure and ashes. This application makes the silt retentive of moisture and the rise of capillary water from the water table keeps the silt in a condition which favours optimum decomposition of the farmyard manure. Application of mustard cake or any oilcake has been found to be useful in obtaining increased yields. It is quite possible that nitrogen, phosphorus and potassium that are required by the crop may be available in proper proportion from the decomposition or mineralization of the oilcakes. In lighter soils addition of potash, besides dung or farmyard manure, has been found to be necessary in England by Sir John Russel. It is therefore likely that potash status may be the deciding factor in the growing of the potato crop in river beds successfully. (B.P.P. & S.V.D.)

What's doing in All-India

CENTRAL PROVINCES AND BERAR

S. P. PIMPLIKAR

THE growing seriousness of the food situation in India and the urgent necessity for increasing the production of food in the country, have brought about a very considerable expansion in the activities of the Agriculture Department. The normal activities of the Department continue as before on well-established lines, but on an increased scale. The new activities can be grouped under two main heads—(i) 'Grow more food' campaign (ii) The Post-war development plan.

'Grow more food' campaign

The 'grow more food' campaign is run on the general lines indicated by the Government of India and includes schemes under three major heads :

Distribution of seeds: In order to enable cultivators to increase the area under food crops like rice, groundnut, wheat and potatoes, it is essential to distribute the seeds on easy terms. Seeds of improved varieties of paddy are being distributed at 12½ per cent, of wheat at 10 per cent below the cost and in the case of groundnut and *kharif* potato seeds are paid for either in cash or on *taccavi*, free of interest, recoverable in one instalment after the harvest of the crops. The *rabi* seed potatoes will be issued either in cash or on usual terms and conditions of *taccavi*.

Manures and fertilizers: These include groundnut cake, ammonium sulphate, ammonium phosphate, bone-meal and super-phosphate; preparation and distribution of compost from town-refuse are also important items of work. Groundnut cake is issued for manuring paddy, *jowar* and wheat at 15⅝ per cent below the cost price either in cash or on *taccavi*, free of interest, recoverable in one instalment. The fertilizers are given at 25 per cent below the cost price either in cash or on *taccavi*, free of interest, recoverable in one instalment, for manuring paddy and wheat; while they are distributed at cost price for manuring of sugarcane and vegetables. The town-compost is issued at half the cost price in places in which there is marked prejudice against its use and at full price in places where the prejudice is less marked. The value of the usefulness of this compost for crop production is being increasingly realized by the cultivators.

Land improvement and irrigation: There are various schemes relating to land improvement and irrigation. Under these schemes, loans on easy terms are sanctioned to cultivators for digging new wells and for repairs to old ones. The maximum rate is Rs. 1,000 per well for new construction and Rs. 400 for repairs to old wells. Of the advance, 20 per cent is to be treated as subsidy and the rest is to be recovered in five years. The amount of the subsidy is to be remitted in the fifth year. Other terms remaining the same, loans for construction of new tanks and repairs to old ones are provided for at Rs. 150 per acre of commanded area, but the subsidy in these cases is 50 per cent of the loans advanced. The subsidies in case of construction of field embankments for converting *rabi* areas into *dofasli* and for repairs to old paddy bunds are one-sixteenth of the loans advanced. The terms and conditions are the same in all the land-improvement schemes, except the fixation of the subsidy which is detailed above. The loans given are free of interest in the first year and thereafter carry a concessional rate of interest at 3¼ per cent. The loans are to be recovered in five years.

New schemes

During 1947-48 the following new schemes will be introduced :

(1) Eradication of *kans* by deep mechanical cultivation by tractors.

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(2) Distribution of *rahats* for lifting water from wells for irrigating additional areas.

The concessions under these schemes are yet to be decided and will be made known to the general public as soon as a decision has been taken. It is proposed to intensify the 'grow more food' programme during the next five years with a view to produce at least two lac tons of extra food grains in the province. It is expected that many of these schemes, particularly land improvement and irrigation will bring permanent benefit to cultivators in this province.

The total net expenditure under these schemes in 1947-48 is estimated at Rs. 31·40 lacs inclusive of subsidy, and this will be shared equally between the Provincial and Central Governments. A sum of Rs. 78·76 lacs is also required for advancing loans which are recoverable.

Developmental plans

The Agriculture Department has formulated many schemes in the post-war reconstruction plan. A few of these have been sanctioned and have come into operation, but the more important development schemes are still awaiting Government's sanction.

For the execution of the various developmental schemes, a large increase in the personnel of the Agriculture Department is necessary. The first step therefore is to train the staff necessary to work the various schemes. With this end in view, a number of training classes have been started. Three classes were started in 1944 for training agricultural overseers (Scheme for the Training of Agricultural Overseers), one each at Betul, Ellichpur and Chandkhuri (Raipur District). So far 213 agricultural overseers have been trained and all of them have been employed by the Department in the various food production drives and post-war developmental schemes.

Four classes have also been started for training demonstration *jamadars* (Scheme for the Training of Demonstration *jamadars*). The classes are situated at Nagpur, Damoh, Buldana and Labhandi (Raipur). The training lasts for a period of six months. So far, 301 demonstration *jamadars* have been trained and all of them have been absorbed in the Department.

With a view to increase the number of graduates in Agricultural Department the facilities available for training at the College of Agriculture, Nagpur, were expanded (Scheme for the Training of Agricultural Assistants) and the number of students admitted in the first year was increased. Since 1946, about 80 students are admitted each year in the first year class as against 45 or 50 some five years ago. It is expected, this scheme will produce about 35 additional graduates every year from 1950 for employment in the Department.

With a view to meet the demand for trained men to work as estate managers for big landlords and *malguzars*, a training class for village managers was started in 1945 (Scheme for the Training of Village Managers). Twelve candidates are admitted to the class every year. Only one batch of students has so far completed the course. Of these, eight have been employed in various estates.

Since 1945, the Government have also embarked on a policy of sending abroad promising Departmental Officers (Scheme for Training Abroad) for advanced studies in order to appoint them in the various developmental schemes after their training. Four officers have already been sent and one of them has recently returned after training in the United Kingdom.

Recently the Government have also decided to get a number of men trained in the various post-graduate training institutions in India (Scheme for Training in India) in special subjects. Three persons have already been sent for training in horticulture and 15 more persons are to be trained this year in various agricultural subjects.

A Fruit and Vegetable Experimental Station has recently been started at Sendri (Bilaspur); this is intended to produce seeds of improved varieties of vegetables and fruit plants. It is expected that the supply of seeds and seedlings will commence very soon.

In order to encourage bee-keeping as a subsidiary occupation by the agriculturists in regions where facilities for the same are available, three bee-keeping stations have been started at Nagpur, Seoni and Pachmarhi. In addition to disseminating the knowledge relating to bee-keeping, the centres will also undertake the study of important problems regarding the development of bee-keeping in this province. The Nagpur and Seoni centres have already started work.

The Government have sanctioned a scheme

for the development of marketing in this province. Although this province has an Agricultural Produce Markets Act, many of the important markets of agricultural produce are still functioning under the Municipalities' Act and irregularities and malpractices are not altogether absent. It is expected that the scheme recently sanctioned will help to bring all these markets under the control of Agricultural Produce Markets Act and improve marketing conditions in this province.

Some of the schemes awaiting sanction are intended to bring about a permanent improvement of the agricultural conditions of the province. The list includes schemes for the production of high yielding and disease-resistant varieties of all important crops like rice, wheat, millets, pulses, oilseeds and cotton.

To help the cultivators to undertake cultivation operations timely and particularly to help them in ploughing and improving lands that are infested with pernicious weeds, it is proposed to establish a number of machine and tractor stations at important centres for hiring out tractors and other agricultural machinery to the neighbouring cultivators at reasonable rates. A scheme is also under contemplation for reclaiming lands that have gone out of cultivation in the northern districts on account of infestation by *kans* by deep ploughing by heavy tractors.

It is also proposed to establish a seed store in each *tahsil* for facilitating the distribution of improved seeds and manures to cultivators.

It is also proposed to introduce cooperative farming in the province. A scheme for the cooperative cultivation of sugarcane and its rotation crops in a village in Bilaspur District has been drawn up and is under the consideration of the Government.

ASSAM

N. K. DAS

A NEW development relating to the food production drive in Assam is the recent formation by the Government of Assam of an Advisory Council for increased food production. This Council which consists of fifteen members includes the Hon'ble Ministers for Food and Agriculture, the Directors of Agriculture and Supply Departments and the Economic Adviser to the Government of Assam. According to the orders of the Government, the functions of the Advisory Council will be as follows:

1. Improvement in the organization of the Agricultural Department.
2. Suggestions as to the coordination of the activities of the non-official committees that will be set up.
3. Suggestions for improvement of the present statistical machinery regarding agricultural production.
4. Suggestions with regard to organization for mechanized agriculture.
5. Fixation of target for production.
6. Review of the work that is being done.

The Council is expected to meet monthly at different places of the province. The first meeting was held at Gauhati on 7 and 8 January, 1948 with the Hon'ble Minister for Food in the chair.

Village committees

In his presidential address the Hon'ble Minister drew the attention of the members to the position in regard to the production of food in the province of Assam which has to import annually large quantities of foodstuffs like pulses, mustard oil and *gur*. He also referred to the food shortage in the Indian Dominion as a whole, the difficulties experienced and the losses incurred by the Government of India in importing food and said *inter alia*:

'Our objective must be maximum production of food and equitable distribution with full employment in rural areas within a period of say 15 years. It would surely mean raising of the nutritional standard and also standard of living. To coordinate the activities of cultivators, I intend to organize throughout the province small committees having jurisdiction over one or two villages which will be our

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village unit of production......Organization of these units of production will be defective if attention is not paid to the present stumbling block to agricultural development which may be classified thus:

(1) Existence of uneconomic holdings.
(2) Exploitation by land owners.

Useful suggestions

He also suggested that there should be a Board for Agricultural Development in the province and that there should be a separate directorate for the 'grow more food' campaign. He also stressed the necessity of making 'a survey of all available waste lands', adopting measures for 'planned settlement', improving cattle for the purpose of increasing milk supply and providing more efficient agricultural power, establishing a 'Central Statistical Bureau' and of having a marketing section in the Department of Agriculture to benefit the producers.

The items on the agenda of the meeting related mainly to the question of fixation of targets of production. Although no specific targets were fixed at this meeting, the deliberations brought out in detail the present position and a few resolutions were passed regarding the lines of future activities. Two sub-committees were formed, one for reporting on the subject of mechanization of agriculture and the other on the subject of improvement of statistics.

It is hoped that the collective mind represented by the Food Advisory Council will tackle the problem of stepping up food production most effectively and in all its aspects.

Exhibition

The Department of Agriculture sponsored the idea of an annual exhibition to be held at different places in the province with a view to giving publicity to the activities of all the nation-building departments of the Government of Assam and educating the masses. The scheme has been sanctioned, for the time being for one year only. The first exhibition will be held at Jorhat about the third week of February next.

Rough lemon as a root-stock for citrus

The Citrus Research Station at Burnihat, partly financed by the Indian Council of Agricultural Research, has been in existence for the last several years. The most valuable and interesting items of work are the classification of citrus and the trial of root-stocks. Assam has a wealth of citrus fruits and when their classification is completed, a substantial addition will have been made to the existing literature on the horticultural science. The trial of several indigenous root-stocks has so far shown that rough lemon (called *Soh Myndong* in Khasi) furnishes the most cosmopolitan root-stock for citrus in general. It has so far been found to be the best stock for both tight skinned and loose skinned oranges. The observations so far recorded, though insufficient for final scientific conclusions, are considered to provide some guidance for the practical development work now going on under a special scheme for horticultural development.

Agricultural education

Assam has so long been dependent on other provinces in the matter of training students in agriculture. It is now going to have its own institutions for the purpose. Preliminary steps are already being taken to establish an agricultural college at Jorhat in connection with post-war agricultural development. There will also be two agricultural schools in the near future—one at Gauhati and the other at Jorhat. Construction of buildings for the schools is already under way.

Across the Borders

ANIMAL HUSBANDRY IN A CHANGING WORLD[*]

By MAX HENRY

'THE old order changeth, yielding place to new,
And God fulfils himself in many ways
Lest one good custom should corrupt the world.'

It is doubtful if the poet intended his verse to be applied to livestock raising and management, but it could well be adopted to that end. In the first place it is evident that change is no new thing, and secondly that change may be desirable. For proof that change may be undesirable, consider those changes in animal husbandry, which led to the excessive destruction of timber, the overstocking of our western lands and the introduction of wrinkles to Merino sheep.

If the history of livestock raising and management is studied it will be clear that the methods adopted are always changing. The tempo of these changes waxes and wanes, but change goes on. At periods of great stress there is a tendency for change to be more marked and sought after; the periods of great wars are inevitably such periods, and men seek change because what is present is associated in their minds with dramatic and often undesirable happenings.

If we review the livestock situation in this country as it stood before the last war, and as it stands today we shall find little change, but a foreshadowing of changes to come. None of these foreshadowed trends is new, but some represent an intensity of action which might not have occurred had the last war been avoided.

The interest in scientific feeding

It is interesting to note that many of our chief problems are still the same. It will, for instance, probably not be contested that one of the failures of our past has been the failure to adopt methods of feeding livestock apart from grazing. During the years between the two wars interest in the adoption of various methods of feeding was undoubtedly increasing, though on a somewhat empirical basis. The major change in our outlook now should be the utilization of scientific knowledge of the value of different types of feed, and the building up of routine practices which are based on such knowledge. The close examination of the economical side of such methods should be a complementary step. We may see this exemplified in the present day work of the Division of Animal Industry of the Department of Agriculture, the Council for Scientific and Industrial Research and the University Veterinary School.

New facts about grain feeds

The war has also had the somewhat unexpected result of teaching us new facts as regards the value of certain grains. Everyone has, to some extent, been astonished at the degree to which wheat could be utilized to feed livestock of all descriptions. Incidentally we also learnt some new facts regarding its limitations, particularly when fed in excess to poultry. We have also had our attention turned to the grain sorghums, which seem likely to oust wheat to a large extent from our feeding practices. No doubt other examples could be mentioned, but these are referred to with the idea of illustrating our rather narrow outlook on feedstuffs.

Perhaps the influence of the war will do much to broaden our ideas on this point. If so, it will be a definite change in a changing world. Try and imagine the financial saving which would be effected if the majority of stockowners, when hand-feeding, based their practices on the economic use of a wide line of feeds. If we could see, combined with this, the widespread adoption of fodder conservation based on the idea of growing and storing feed on the farm on which it is to be used, then indeed would we see a changed world. It would be a world in which the idea of creating depots of fodder at so called strategic points would be scouted as futile. Also it would lead to the abolition of concession rates for fodder for starving stock on the railways. It is high time that people realized that this is an obsolete method of dealing with a tragic situation. Are we sufficiently in earnest about change to see in its true light the tragedy and horror of starving stock ?

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[*] Notes of an address given at the 1947 State Conference of the Agricultural Bureau of New South Wales. Mr. Henry recently retired from the position of Chief, Division of Animal Industry, Department of Agriculture.

So we may foreshadow with some degree of confidence that feeding will assume a new aspect—as being the normal instead of the abnormal. No Government can bring about the change ; it must arise from the stockowners. What the various Government Departments must do is to carry out experimental work so that the stockowners may be able to secure unbiassed advice. A good deal has actually been done in this direction, but the work requires speeding up by the provision of facilities and enough scientifically-trained men. It must be plain to everyone that we are only at the beginning of our use of scientifically-trained men. These men quite rightly consider themselves of worthy something more than the low rate of remuneration at present deemed sufficient by their employers.

Breeding trends

Just as the question of feeding will be dealt with by a speeding up of present trends, so breeding will follow ideas already in being. There will certainly be less dependence on external appearance in the selection of stud stock. There will arise a demand that many dogmatic statements regarding the linking of external features with high production should be put to the proof. This would be comparatively easy with pigs, poultry and beef cattle, by no means easy with sheep and definitely difficult with dairy cattle ; but it could be done, although it is unlikely to be done without Governmental experimentation. There is a wide field for experiment and investigation to be carried out on the experiment farms of the State Governments, and it would be more payable in the long run than the production of stud stock on the present lines, valuable though that work may be.

The private breeder can produce stud stock, but is unlikely to check the comparative value of features which assist him in securing sales.

Artificial insemination

There will arise a demand for the wider utilization of the few really high class sires known to be capable of reproducing in their offspring, the inherited tendencies towards high production in any given species or breed. To a certain extent this will be brought about through artificial insemination, but there is no justification for assuming that practices now possible in such countries as Denmark and Great Britain are feasible under present conditions here. The relatively small size of the farms, the small numbers in the herds, the greater density of the veterinary population and the close association of practically all farmers with the cooperative movement as exists in Denmark, all influence the position.

Prospective demand for animal products

These changes in feeding and breeding principles are designed to secure maximum production at minimum cost. This intention can only be justified if we can see a demand for animal products in the future. Now during the last war one aspect of the value of animal products has been brought well to the fore. That is the production of what are known as the 'protective foods'; milk, milk products and eggs are the products usually and rightly so referred to. There can be little doubt that the remarkable record put up by the English people in the last five to six years has been associated with the controlled distribution of milk. At the present time the lack of fats, particularly those of animal origin such as butter, lard and dripping, is the most serious defect in English rations.

It may be that in a changed world the authorities will take active steps to ensure to all the population, adequate supplies of milk and animal fats. It may well come to be regarded as a national calamity if supplies of these foods have to be rationed in the big cities. Their supply will be a major weapon in health maintenance.

It will be a natural corollary that the foods produced shall be from healthy animals and handled under the best hygienic conditions.

Livestock and soil fertility

We may safely anticipate that the increasing cost of producing food by improved feeding practices will draw attention to the role of livestock in maintaining soil fertility and minimizing soil erosion. You probably know that in Great Britain and Europe livestock are often kept primarily to produce manure to fertilize the fields. Our methods of animal husbandry have militated against the full use of this benefit. Even making due allowance for that fact, our failure to take any adequate steps to overcome the difficulty still persists.

Manure of animal and vegetable origin cannot be equalled by synthetic chemical fertilizers, simply because we do not know all the constituents of natural manure requisite to the production of healthy plants. Moreover, when we do secure a more complete list, we may not be able to produce them all commercially. Without livestock our soils would deteriorate, though such generation would be in a position to judge the cause. Just as we do not know every constituent of this organic manure, so we do not know every item necessary for the food of animals or man—but we do know enough to be able to refer to the 'protective' foods.

It will be seen from what has been said already that the dairy industry must have a high place in our general economy, but we know that at the present time the productivity of the living units—the cows—is far below the level which would be achieved by improved feeding and to a much less extent, by improvements in breeding practices. Economic pressure may, in the changes to come, force the dairy farmer to secure his return from a small number of higher-producing units. Such a movement would be all to the good.

It will have been noted that in several directions reference has been made to the maintenance of livestock health. The subject is of importance not only from the economic side, but also from that of human health.

The ratio of veterinarians to livestock population

To bring about the desired ends Australia will have to enlarge the activities of the veterinarian and bring the situation here into line with that in such countries as Denmark and Great Britain. In those countries, the ratio of veterinarians to livestock population is far higher than is the case here. The desired expansion is already taking place, but requires speeding up.

It appears certain that the necessary recognition of the far-spread value of livestock to our national economy will result in increased attention to health. Whether the necessary services are to be provided through Government agencies only, or by the more flexible method of Governmental plus private practitioner agencies, only the future will know. Whichever it may be, it will be essential to watch that the training of these veterinarians should be kept on a high plane and a broad basis. Only with money can this be secured.

Nothing revolutionary will occur

One may summarize the situation then by saying that change will continue, probably at a more rapid rate than was the case prior to the last war, but that nothing revolutionary will occur because the fundamental principles of animal husbandry cannot alter.

I finish then, as I began, with a quotation, 'There is no new thing under the sun'.—Reproduced from the *Agricultural Gazette of New South Wales*, October, 1947.

Home Gleanings

COMPOSTING *vs.* DIRECT PLOUGHING IN OF REFUSE MATERIALS

By C. N. ACHARYA

THERE appears to be a certain amount of uncertainty among farmers and even among scientific workers[1] in the field regarding the necessity for composting refuse materials before applying the same to land as manure. In the well-known practice of green manuring the paddy crop, the material is directly ploughed into the soil without any treatment. Howard[2] has recommended a system of sheet composting which is practically tantamount to ploughing the material into the land. Higginbotton[3] has recommended the trenching of refuse materials in the land itself. It is a common practice in certain areas of the country to plough town-refuse (*katchra*) directly into the land, especially for growing potatoes in sandy tracts. Experimental trials carried out at Rothamsted as well as by the writer[4] in India have shown that under certain conditions it is possible to add uncomposted refuse (urban and rural) to the soil with beneficial results on succeeding crop growth.

Simplification needed

The above data and experience would apparently seem to contradict the need for subjecting the refuse materials to the process of composting before applying the same to land. Composting involves a certain amount of labour and it takes some months before the material matures into good manure. If it were possible to avoid the process and apply the refuse directly to land with the same beneficial results, there would be considerable simplification of procedure and saving in labour and time. Possibly the 'organic' programme could be made to appeal to the farmer better by simplifying it as much as possible.

But in our efforts to popularize the use of organic matter on land, we must not lose sight of certain fundamental requirements of good husbandry or recommend an indiscriminate procedure which may do more harm than good to the crops. It is therefore necessary for the farmer to weigh the arguments for and against composting before deciding on the actual procedure to be followed by him on his farm.

Most important consideration

The most important consideration for a farmer is the presence of weed seeds in his refuse material. Both urban refuse (*katchra*) and the farm refuse (litter and dung) are rich in weed seeds and considerable labour and time is spent in eradicating the weeds subsequently after such weed-rich refuse is applied to land as manure. It is therefore necessary that the refuse should be subjected to a proper process of composting which would generate enough heat to destroy the weed seeds. The labour and time spent in compost-making would more than repay the great amount of labour and time that would be necessary subsequently to eradicate the weeds.

Pathogenic organisms

Secondly, there is the question of pathogenic organisms, which pertains especially to urban refuse. In some parts of the country, the habit of applying raw night-soil to land still persists but it would be agreed to all that this system is unhygienic and likely to lead to spread of serious diseases such as cholera, typhoid, dysentery, etc. In China, the wide-spread infection of hook-worm, morbidity and

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[1] *Rural India*, September 1947, pp. 301, 302

[2] *An Agricultural Testament*, 1942. Oxford University Press, pp. 92, 227

[3] *Trenching* by Sam Higginbotton, 1945. Kitabistan, Allahabad

[4] Pot culture experiments with composted and uncomposted refuse materials, *Indian J. agric. Sci.*, June 1946

intestinal disorders is attributed to the prevalent custom of applying raw night-soil to land. It is necessary to compost night-soil before utilizing it as manure. *Katchra* (dry refuse) is less dangerous, but it is safe to compost this also before applying it to land. Town *katchra* usually contains a lot of undesirable materials such as glass, tin, broken porcelain, leather, etc., and it is difficult to remove these by sieving or hand-picking, while the *katchra* is raw. After composting, however, the above foreign materials could be easily removed by sieving through expanded metal or wire-mesh, and a fine type of manure equal to rich farm-yard manure is obtained.

Carbon-nitrogen ratio

There is also the question of C/N ratio to be considered. Most farm and town wastes (omitting urine, night-soil) are poor in nitrogen and possess rather wide C/N ratios. Thus, straw possesses a C/N ratio of about 60 to 70, while sugarcane trash shows a C/N ratio as wide as 100 to 120. It has been experimentally shown that materials which possess C/N ratios wider than 15-20 fix the available nitrogen in the soil for their own use and render it unavailable to the succeeding crop, which naturally suffers. Thus, crop yields may be actually lowered by indiscriminate application of straw and sugarcane trash to land. In the process of compost-making the C/N of the refuse is brought down to a level of 15 or narrower and such manure releases available nitrogen from its own body and thus increases the quantity of nitrogen available to the crop in the soil. As such, the crop yield is increased by use of ripe manure. If composting is omitted, a long period of four to six months must be left for the refuse to decompose properly in the soil and in that period no crop can be grown. If there is no rainfall in the above period the refuse may not decompose at all in the soil.

Soil moisture

There is also the highly important question of soil moisture. If large quantities of undecomposed straw or town *katchra* are added to the soil, these fix all the available moisture in the soil for their own decomposition. In the *barani* tracts of medium to low rainfall, it would be a highly risky business to apply undecomposed material to the soil, for it would hasten the failure of the succeeding crop. Only low doses of well-decomposed manure should be applied to such lands. It is possible to apply undecomposed material only to lands under irrigation or where rainfall is abundant (say about 50 in.) and the water supply is well-distributed over the season, so that it would provide for the requirements of the undecomposed materials as well as of the succeeding crop. This practice is mainly possible only in the paddy (rice) tracts, where green manuring is already a general practice.

Readiness of land

Another factor to be considered is the readiness of the land itself to receive the manure. This has to be applied to land only in the season, which may come once in six months or once a year. But farm refuse (e.g. litter, dung, urine-earth, weeds, etc.) are being collected every day and would have to be properly stored till the time comes for their application to land. An efficient form of storage is practically tantamount to a simple form of compost-making.

Simple compost-making

If the system of compost-making is to become popular among our farmers, villagers and municipalities, it should be quite simple and should minimize labour and attention as much as possible, so that the farmer treats it more as a method of storage than of composting. But at the same time it should achieve the main objects of compost-making, viz. destruction of weed seeds and pathogenic organisms and narrowing of the C/N ratio to a level below 15. Such a simple system of compost-making as applied to urban and farm wastes has been described by the writer elsewhere[5],[6] and is now widely propagated in this country under the Urban and Village Compost Schemes operated by the Provincial Governments and the Government of India. About 600 municipalities and 800 villages are already operating the above simple process with highly successful results and more are joining day by day.—Reproduced from *Rural India*, December, 1947.

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[5] *Misc. Bull.* No. **60** of the I.C.A.R.

[6] *Indian Farming*, May 1945 (p. 214) and December 1945 (p. 569)

Book Reviews

THE AGRICULTURAL DEVELOPMENT OF THE MIDDLE EAST

By B. A. Keen, D.Sc., F.R.S. (His Majesty's Stationery Office, London, 1946).

THIS book is of fascinating interest and is crammed with useful matter. To an Indian anxious for the agricultural development and land utilization of his country it is very valuable, as it deals with the agricultural condition of the tracts from which India has much to learn.

In 1943 the British and American Governments agreed to the appointment of a Scientific Advisory Mission to the Middle East Supply Centre, established by the British Government in 1941 and made into a joint Anglo-American Agency in 1942.

The first members of the Mission were Dr B. A. Keen, F.R.S., Assistant Director of Rothamsted Agricultural Experimental Station, and Dr E. B. Worthington, Director of the Freshwater Biological Association. At a later date, Dr Allen was appointed to advise on rural education and finally Dr N. C. Wright was requested to survey some of the major problems of livestock production.

One of the main underlying objects was to obtain a comprehensive and objective appreciation of some of the main scientific and technical problems facing the Middle East region. The Mission was composed of men, each distinguished in his particular field of study, yet without any previous specialized knowledge of the area concerned. It was felt that an appreciation of this kind could not but be of lasting value.

The report refers to 14 countries with a population of perhaps 70 million, and extends from Cyprus in the north to the Sudan in the south, and from Persia in the east to Tripolitania in the west. Its climate ranges between the extremes of rainless desert and copiously watered hill forest. It displays all stages of agricultural development from the immemorial nomadic pastoral type to the most advanced irrigation farming having all shades of efficiency and inefficiency.

The book is divided into Foreword, Acknowledgements and Introduction followed by six chapters, viz.

(i) Outline of Middle East Agriculture by territories (Cyprus, Palestine, Syria and the Lebanon, Transjordan, Iraq, Persia, Egypt, The Sudan, Eritrea Ethiopia, The Aden Protectorate, Tripolitania and Cyrenaica
(ii) The obstacles to agricultural improvement
(iii) Methods of raising agricultural standards
(iv) Scientific and technical problems
(v) The supply and development of agricultural information and advice
(vi) Conclusions and summary of recommendations

There are, in addition, two appendices, 30 illustrations and an index.

The Middle East is predominantly an agricultural region and will be so for a long time to come ; with exceptions, it is not an inherently fertile area and cannot be made so in a short time. Yet it is an area where the population is increasing rapidly and consequently there is the great danger of a fall of the standard of living, unless early action is taken to remedy the factors which prevent an increase in food production. In this respect there is much in common with the Middle East and India.

As in India the problems in these regions are interlocked in a social and agricultural system which, in spite of its basic simplicity has many technical difficulties. The cultivator, for all practical purposes, is in the grip of a farming and social system that necessitates the continuance of the very practices that the reformers deplore. In all essentials the complex of the social organization and the system of agriculture in the Middle East is like the one that endured so long in western Europe and still exists in India.

The land tenure is based on a complicated and ancient system in which those who have absolute or hereditary titles are to all intents absentee landlords. In view of limitations of space only a few of the more notable aspects have been picked up at random and presented here.

There are a number of peasant proprietors also. In Egypt the 1933 figures showed that no less than two-thirds of the landowners held, on an average, only two-fifths of an acre each. This has a parallel in India also. Such minute holdings could hardly be economically sound and the consequence is that throughout the Middle East, as in India, this class is in the grip of the money-lender.

In Chapter III, in connection with the method of raising agricultural standards, the problem has been considered from two angles. The first is how far and by what means, improvements can be made in the existing system without altering its essential agricultural and social structure. The second is whether there are opportunities for developing better structures, and, if so, what forms they should take. In connection with the first one (developing new system) much valuable guidance has been obtained from a number of largescale agricultural developments already existing in the Middle East. These are:

Sudan: the Sudan Plantations Syndicate; the Government's Alternative Livelihood Schemes; the Cash Board.

Palestine: the Jewish agricultural settlements; the citrus industry; private farming.

Iraq: the Latifiyah Estates; the date industry.

Libya (Tripolitania and Cyrenaica): the Italian colonization.

Cyprus: the Cooperative Societies.

It will be out of place to give details of all these schemes but it may be stated that in the case of Sudan Plantations Syndicate, it is operated on a share-farming system by a triple partnership of Government, tenant cultivators, and Sudan Plantations Syndicate, whose basic shares are, respectively, 40 per cent, 40 per cent and 20 per cent. The rights of the original landowners of the area are protected. Provisions exist to prevent the fragmentation of holdings and sale to merchants or absentee landlords. This Scheme has also improved the food position of the country. Before the war it contributed 20 per cent of the gross revenue. The tenant has benefited considerably. He has security of tenure; skilled advice and guidance is available; the stranglehold of the money-lender and the merchants is lessened. Amongst other points of interest the Jewish agricultural settlement in Palestine stand out prominently. The Italian Developments, Tripolitania and Cyrenaica (Libya), also deserve mention. The Jewish agriculture system now differs greatly from Arab ones. The Arab system generally consists of a two-year rotation in which winter crop of wheat or barley is rotated with a winter leguminous crop, or with a summer crop (in the succeeding, not the same, year) such as *dura* (millet) or sesame. A three-year rotation is also used: a cereal, a legume, and a summer crop. These rotations suffer from the obvious defect of not providing animal fodder for the whole year, and from lack of manure. Such supplies as accumulate near the villages seem either to be left unused or else sold for use in the citrus plantations. Arab livestock are managed in the traditional way, either as nomadic flocks or pastured on the stubbles and land not under cultivation. The Jewish agricultural system and the sociological framework of their colonies are closely connected. The land belongs to the Jewish National Fund and is leased to settlers on hereditary perpetual lease under special conditions. The settlements are of two main types, collective and small holdings. The former vary in size from a small collective group (kvutza) to a large one (Kibutz) for 40-200 families who, as a single group, run one large farm or, more accurately, an estate, whose social and economic structure resembles that of the Russian communal farm (Kolkoz). The latter type, the small holdings, are essentially cooperative settlements; each family independently runs its own farm, with a well-developed cooperative system for its products and requirements.

It should be noted here that the Indian Delegation on Cooperative Farming in Palestine has also spoken in high terms of the methods and have remarked that the extent of mutual goodwill and cooperation practised is almost Utopian. There is not the least doubt that it is a unique experiment in the world and constitutes a fruitful lesson for India but unfortunately the social and other conditions here are too formidable to vouch for its success or adoption.

Regarding the Italian Developments, Tripolitania and Cyrenaica (Libya), the author has referred to two useful points. The first is that much of the success depends on the resident manager, especially in the early stages (the colony was fortunate in this respect); the second is that ultimate ownership of the holding is not an essential feature of successful small-scale farming.

All over the Middle East the methods needed to foster the process of evolutionary change are all, in essence, educational. Among the problems are :

(a) to develop among the larger landowners a sense of their responsibilities to the land and the workers,

(b) to cultivate among the tenants and peasant proprietors a desire to improve their lot,

(c) to evolve a type of education for rural children that will fit them to live in and profit by a rural environment,

(d) to train teachers for rural schools, and members for the Agricultural Department, who will be able to evoke enthusiasm for and guide the move towards rural improvement.

In this connection the American University of Beirut and its associated Institute of Rural Life are reported to be doing very useful work.

There is another interesting point in this Report.

This refers to the organic matter and its relations to the soil. The poor yields of crops and the ravages of erosion are both ascribed to the lack of organic matter. Dr Keen points out that although much work has been done on the status of soil organic matter in temperate agriculture, there has been until recently very little examination of the problem under climatic conditions similar to the Middle East. The decomposition of organic material in the soil is essentially an oxidation process and, in Middle East conditions, much of its content of nitrogenous plant nutrients may be lost as gaseous products. Dr Keen therefore points out that unless some system of husbandry can be devised in which the crops can utilize a good proportion of the nitrogenous material, the advocacy of increased organic manuring as a means of increasing fertility is hardly justified. Here he throws out a new suggestion, viz. that a good case could be made out for the peasant's custom—so generally condemned—of using dung as fuel. If so small a proportion of nitrogenous value of the dung is available to plants, on account of rapid oxidation, is it not better to use the heat of oxidation for domestic purposes than to lose it uselessly in the soil ?

Finally he points out that on account of the lack of a closer integration between crop and animal husbandries, the outlook of a veterinarian and agriculturist much differs there as compared with that of temperate regions, and he emphasizes the need of a closer association in view of the intrinsic importance of fodder and nutrition and their bearing on mixed farming and agriculture. (I.C.)

News and Views

RICE: THE POSITION TODAY

A LIMITED allocation of rice to European countries from non-European sources (other than Iran) has been recommended by the International Emergency Food Council for the first six months of 1948. In 1945, Britain's Government stopped rice imports for civilian consumption in order to conserve as much rice as possible for the rice-eating peoples in Asia, and, following Britain's example, no rice allocations were made to Europe from non-European sources. In fact, only some 5,000 tons of rice were shipped to Europe in 1946, which proves the success of international cooperation in the field of food distribution.

The new recommendation provides only for 'token imports' of 61,000 tons in the first six months of this year. That these imports constitute indeed only a token, is evident from the fact that Europe's annual rice import amounted to about 1,200,000 tons before World War II. Twenty-one thousand tons are to be supplied from Burma, 7,000 tons each from Brazil, Ecuador, the United States and Siam, and 12,000 tons from Egypt. Britain is to receive 24,500 tons, France 10,000 tons, the Netherlands and Czechoslovakia each 5,000 tons, and smaller quantities are allocated to Belgium, Austria, Greece, Poland and Eire.

The recommendation constitutes a temporary exception to the established policy of recommending no imports of rice to European countries other than those from sources of supply in Europe and from Iran. In granting this exception, the Council accepted the assurance advanced by the governments of rice-producing countries that limited exports of rice to Europe would help to increase total world export availabilities to a maximum, and recognized, in so far as possible, the many requests from European countries for small quantities of rice for special purposes (primarily child-feeding, and hospital use).

The operation of this measure will be kept under constant scrutiny in the light of its effects on overall export availabilities and on the cooperation by importing countries on observing the recommended distribution. This exception to the established policy is viewed by the Council not only as an incentive to suppliers, but as a deterrent to movements of rice not recommended by the Council. If it is found that it does not achieve the desired ends, the recommendation will be withdrawn at once.

The recovery of rice production in Asia, the main rice-producing area in the world, is indeed proceeding so slowly that exportable supplies from this area remain for the first six months of 1948 less than one-half of these actually moving prior to World War II and only one-third of the stated requirements submitted by the rice-importing countries. The International Emergency Food Council has recommended the distribution of a total of 1,449,000 tons of rice for the first six months of 1948. This quantity, representing supplies expected to be available for export during the period, is only slightly higher than the 1,173,200 tons actually exported during the corresponding period of 1947.

The major improvement in export availabilities has taken place in Burma, whose estimate of rice shipments during the first six months of 1948 is 800,000 tons, about one-half of her pre-war six months average of 1,475,000 tons, but 50 per cent more than in the corresponding period of 1947. Siam is expected to ship less than 250,000 tons—one-third of her pre-war six months average of 625,000 tons.

Prospects of shipments from French Indo-China are only 10,000 tons compared with 650,000 tons before World War II. Exports from countries in the Western Hemisphere have greatly increased since World War II, but are far from sufficient to bridge the gap. The major exporters outside the Far East for the period January-June, 1948, are the United States with 160,000 tons, Egypt with 100,000 tons, Brazil with 75,000 tons, and Ecuador with 40,000 tons.

Among the 21 importing nations or dependent territories for which allocations have been recommended are India with 390,000 tons, Malaya with 205,000 tons, China with 200,000 tons, and Ceylon with 185,000 tons. Export supplies from Latin American sources other than the quantities included in the allocation are for those Latin American countries not specially enumerated in the recommendations (the only Latin American rice-importing country included in the allocation is Cuba which is to receive 90,000 tons of rice).

In pursuance of the recommendations of the International Emergency Food Council, agreement has been reached between Britain and Brazil for the immediate sale of 75,400 tons of Brazilian rice for distribution in the Far East. As its 1947 quota, India is to receive 50,400 tons of rice in exchange for 25,000 tons of jute, and Britain has bought the remaining 25,000 tons. (*B.I.S.*)

INDIAN SOCIETY OF AGRICULTURAL STATISTICS

THE first annual meeting of the Society was held at New Delhi from 11 to 14 December, 1947. The meeting opened on 11 December with a Presidential Address by the Hon'ble Dr Rajendra Prasad, Minister for Food and Agriculture and President of the Society. The President referred to the poor quality of the published agricultural statistics and stressed the need for improving it both as regards completion and accuracy, as, without reliable statistics, no planning of any kind was possible. Although food was the greatest problem facing the country, no policy for food could be formulated for want of reliable data. Emphasizing the need for building up an adequate statistical organization, he urged Statisticians to develop scientific methods like those of random sampling and air photography for reducing the cost and time in collecting data.

On 12 December, a symposium on 'Statistical Organization for India with Special Reference to Agriculture' was held under the chairmanship of the Hon'ble Mr. R. K. Shanmukham Chetty, Minister for Finance. Opening the symposium, he said that the building up of a statistical organization must really be given top priority, for, the government cannot plan in a rational manner their food policy withour reliable statistics. He said that the Government was considering proposals for strengthening the central statistical organization and examining as to how far individual Departments should be engaged in the collection of statistics and to what extent the central organization should control the collection in individual Departments and in what manner it should coordinate the data, and added that the Society's guidance in these matters would be most valuable. The main speakers were Dr V. G. Panse, Institute of Plant Industry, Indore, Mr. W. R. Natu, Economic and Statistical Adviser, Ministry of Agriculture, Government of India, New Delhi and Dr P. V. Sukhatme, Indian Council of Agriculture, New Delhi. Dr Panse and Mr. Natu emphasized that the collection of statistics, the training of statistical personnel and research in statistical methods should be the responsibility of the individual Ministries concerned, as, in their view, a close contact with the field to which statistics is applied was a pre-requisite for the growth of efficient statistical service. Dr Sukhatme, describing his recent experiences in America, said that the collection of statistics in the States was generally decentralized among the Ministries concerned, each operating within its own respective field. He revealed that Statistical Bureaux attached to the various Ministries under the Government had technically qualified statistical staff engaged in continuous research into the quality of data collected from day to day, and ascribed the major developments in statistical science like those of area sampling in agriculture, the scheme of sub-stratification for area, and others to the intimate association of statisticians with the field of application. He said that the lesson to be learnt from these developments in the United States was that the organization for training and research in agricultural statistics in India must be developed within the Ministry concerned and not form a part of a Central Institute of omnibus character.

Others participating in the symposium were Prof. K. B. Madhava, Mr. K. Kishen (Lucknow), Mr. R. S. Koshal and Dr N. S. R. Sastry (Bombay).

On 13 December, a second symposium on 'Contribution of Statistical Science to the Development of Indian Agriculture' was held under the chairmanship of Prof. J. N. Warner of the Allahabad Agricultural Institute. Dr N. S. R. Sastry, opening the symposium, dwelt on the role of statistical science in agricultural economics. He was followed by Messrs. V. D. Thawani, A. R. Roy, S. S. Iyer, S. D. Bokil, K. Kishen, R. S. Koshal and M. V. N. Rao, who described the varied applications of statistics in different branches of agriculture, including plant breeding, design of experiments, animal husbandry, fisheries, etc. On 14 December, papers were read. Prof. K. B. Madhava took the chair.

The meeting was largely attended. Agricultural Statisticians from most provinces were present. Among those who sent messages of greetings were Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research, New Delhi, Sir C. V. Raman, President, Indian Academy of Science, Bangalore, and Sir Shri Ram, Delhi.

It was announced at the meeting that arrangements for the publication of the Society's *Journal* were fairly advanced. A special feature of the *Journal* would be a Hindi supplement giving summaries of the articles published.

Sardar Bahadur Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research, was elected as the first Executive President of the Society for the next year. Other office-bearers are Mr. M. S. Randhawa, Vice-President and Dr P. V. Sukhatme, Secretary. (I.S.A.S.)

COVER ILLUSTRATION

A South Indian village scene.
(Photo by Mrs. Stan Harding)

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 4
APRIL 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.4.48
2,800

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London WC 2.

INDIAN FARMING

APRIL, 1948

Vol. IX No. 4

THE MILK PROBLEM IN INDIA

ELSEWHERE in this Journal we present a series of articles bearing on some aspects of milk industry with special reference to the conditions in India. The reorganization of the nation's milk industry is one of the major problems that is exercising the minds of everyone concerned in the well-being of the population. The matter has received a good deal of attention and publicity both on the platform and in the press. Several steps calculated to bring about an improvement in the national milk position, have been taken by both official as well as non-official organization. The process of reconstruction, however, appears to be painfully slow and the happy moment of consummation, when every child, nursing mother and adult in this vast sub-continent would be provided with an adequate, if not a plentiful, supply of wholesome milk, is still a distant vision only. The regeneration of the milk industry is a matter of extreme urgency since it is vitally linked with the economic prosperity of the country in several ways. Apart from its intrinsic importance as a valuable food, milk together with its derivatives, constitutes the only source of animal protein and protective substances for the vast majority of the people, who are accustomed to a rigid vegetarian diet. In addition, dairying is closely connected with agriculture which is the mainstay of Indian economic life, and unless an efficient milk industry is in existence, no successful agricultural policy can be formulated.

In connection with the improvement of the milk position, there are two aspects to be considered, namely, increased production of milk and improvement of the quality of market milk supply. In both these respects, the present position in the country is extremely disheartening. India is credited to possess the highest milch cattle population in the world (66·4 millions according to 1941 census), but the total annual output of milk is only about 6,400 million gallons, i.e. 96·4 gallons per head of cattle and 8 oz. per head of human population. In contrast to this, about 11·8 thousand million gallons of milk were produced in the United States of America annually during the war years with only 25·3 millions of milch cattle, which works out to 466 gallons per head of cattle per lactation and 35 oz. daily per head of human population. The average *per capita* consumption of milk (including milk products) in India is only 7 oz. as against the minimum of 21 oz. required from the standpoint of balanced nutrition. The actual amount of fluid milk reaching the consumers would be still less since only about 30 per cent of the total milk production is available for consumption, the rest being utilized for milk products manufacture, mainly *ghee*. The serious effects of this low consumption of milk are strikingly manifested in the high infant mortality rates and the appalling state of ill-health among nursing mothers, children as well as the general population of the country. The main factors responsible for this deficiency of milk supply are recognized to be (i) the poor productive capacity of the milch animals, (ii) the concentration of milk production in isolated pockets of the country without any facilities for transporting milk to deficit areas, and (iii) the enormous wastage of milk due to souring or other causes or its conversion into uneconomic products. With greater attention being paid in recent years to better methods of feeding, selective breeding and scientific management of the herd, considerable increase in the yield has been effected and further improvement is in sight. The other two factors are, however, more complicated.

While an adequate quantity of milk is essential for providing sufficient nutrition to the people, the qualitative aspect of milk production is of the greatest significance since not only does it determine the volume of milk ultimately reaching the consumers in a good condition, but it also bears a fundamental relation to the maintenance of public health and the economic production and utilization of milk. The outstanding importance of milk as a human food is due to the highly nutritive substances which make up its unique composition and its pleasing flavour. Any of these may be seriously impaired due to bacterial activity, physiological or pathological abnormality of the udder, drastic heat treatment and adulteration apart from the effects of improper feeding and certain natural causes. Milk is thus highly perishable in nature and it is always susceptible to microbial infection from the time of its production till its utilization. It is also easily infected by pathogenic organism derived from the animals, human personnel or other sources and is known to communicate several serious diseases like tuberculosis, brucellosis and typhoid to mankind. Inordinate bacterial proliferation in milk is also known to result in the production of certain heat-stable toxins, which create gastro-intestinal diseases, particularly among children. The wholesome value of milk for human consumption and its suitability for various manufacturing purposes are thus enormously affected by any of the above factors and the production of clean and safe milk, with its natural properties unimpaired, is beset with considerable difficulties. It is only after years of intensive research work and the coordinated efforts of the trade, State authorities and the consuming public, that these intricate problems were overcome in countries like the United States, England and Denmark and great advances made in market milk industry. Till about the end of the nineteenth century, there was no organized milk industry in these countries. Sanitation in milk production was unknown. Adulteration with water and addition of preservatives were extensively practised and outbreaks of milk-borne diseases were very common. Within the course of just three or four decades, the methods of milk production and marketing were thoroughly revolutionized and remarkable improvements made in the standard of market milk supply. The principal steps taken in these countries for safeguarding the quality of market milk, which may well form the basis for bringing about similar improvements in less advanced countries like India, were (i) the early rationalization of the methods of milk production and marketing on a collective and organized system, (ii) introduction of sanitary methods in all aspects of the industry, (iii) control and detection of disease infection in the herds, (iv) proper arrangements for the cooling, processing and distribution of milk soon after production, and (v) quality control of market milk. Other outstanding measures which contributed to the rapid advancement of the industry were the universal adoption of pasteurization as a means of rendering milk safe and prolonging its keeping quality, employment of mechanical refrigeration in rail and road transport of milk, official regulations for controlling the production and handling of milk and grading of market milk, educative propaganda and economic improvement of the producer.

The present state of market milk industry in India is more or less similar to that prevailing in Western countries at the end of the 19th century. The quality of milk available in the market, both in respect of its purity as well as its hygienic condition, is considered to be of the lowest standard. The urban milk requirements are met partly through supplies received from town *gowalas*, milk shops and dairies and partly from outlying villages. Due to the unhygienic conditions of production and the questionable methods of handling and transport, over which there is no control, milk is constantly open to infection. The consumers seldom get milk that is free from physical impurities and excessive bacterial content, that has a reasonable keeping quality and that can be confidently declared to be safe for consumption. Fortunately, milk is universally boiled before consumption and this practice has saved many of the likely victims from serious diseases. Adulteration of milk with water and addition of substances like starch, flour, and other substances are widely prevalent. The task of raising the standard of milk production from the present state is certainly a formidable one. The practice of adulteration may be expected to be controlled gradually with the introduction of strict legal measures and the elevation of the economic standard of the people concerned. The improvement in the bacteriological quality of milk is, however, fraught with exceptional difficulties in this country. In the first place, the tropical weather associated with dusty and humid conditions and insanitary methods of production provide a very great scope for bacterial contamination. The types of micro-flora predominating in milk in this country are said to possess a high degree of resistance towards heat and other adverse conditions, while they are remarkably active in bringing about biochemical changes leading to the rapid deterioration of milk. Secondly, high temperatures prevailing here favour a rapid multiplication of bacteria and even the cleanest available milk has a comparatively shorter life while in Western countries, the low atmospheric temperatures provide a natural system of refrigeration and even the worst types of milk will have an appreciably longer life as compared with the average quality of milk here. The ordinary type of market milk can rarely be preserved in a raw condition for more than four to five hours while the better varieties can at best be maintained for some three to four hours longer.

It has also been stated that pasteurization, which has proved so valuable in Western countries in increasing the keeping quality of milk, is not very efficacious for general adoption here due to the high incidence of heat-resistant flora in milk in India which survive the process and bring about rapid spoilage of the heat-treated milk unless it is stored in a refrigerator. A more suitable form of processing for the commercial handling of milk is lacking. Even boiled milk has a limited life since the spore-forming bacteria, which are abundant in milk produced under unclean conditions, are able to withstand boiling temperatures.

All these considerations bring out the importance of producing the cleanest possible milk initially and of minimizing its subsequent contamination during its handling and transport, which in turn necessitates the introduction of strict bacteriological control over all operations connected with the production and handling of milk from the cow to the consumer. It is also evident that the remedies adopted in Western countries cannot be imported here wholesale without modifications suited to local needs and conditions.

The whole problem, therefore, merits very careful consideration and there is an urgent need for the speedy inauguration of an equitable national policy for improving the quality of market milk. It is necessary at the same time to launch effective programmes for cattle improvement and augmentation of milk production. A full-fledged quality control programme cannot be successfully implemented under the existing scattered conditions of milk production. It is essential that the present complacent outlook of the producers as well as the consumers should be completely changed in accordance with modern conditions of living and they must be made to realize the importance of wholesome milk and milk products in their diet and the dire consequences of careless methods of handling milk. It will then be possible to rebuild the whole system of milk production on a collective basis so that clean and safe milk could be economically produced in rural areas and supplied to the nearest consuming centres without neglecting the needs of the villagers. Other important measures called for in this direction include the introduction of a rational scheme of public health control over all operations of the trade, formulation of bacteriological standards for grading market milk, a systematic campaign for the eradication of cattle diseases and creation of suitable inspectorial and advisory staff for enforcing official regulations and giving advice to the trade. The difficulty of transporting liquid milk over long distances from milk pockets to deficit areas brings out the necessity of starting milk drying and condensing factories in suitable places at a very early date. All these developments can be undertaken only on a long-range basis and they would necessarily take some time to materialize. In the meanwhile, since the problem of milk shortage is so acute, some immediate steps are called for in exercising some sort of control over the large-scale handling of milk in larger cities and towns and in organizing some form of consumers' milk stores, either under municipal control or on a cooperative basis, where milk can be purchased from villages and stored at a low temperature for retail distribution to the people.

SOME PUBLIC HEALTH ASPECTS OF MILK INDUSTRY IN INDIA

I. FACTORS AFFECTING THE WHOLESOME VALUE OF MILK

By K. C. SEN and H. LAXMINARAYANA

MILK is regarded as nature's most perfect food. It is indispensable for the growth and development of children, for the restoration to health of invalids and nursing mothers and for the maintenance of health and virility of the adult. There is plenty of evidence to show that insufficient milk consumption is primarily responsible for the high rates of infant mortality and diseases of malnutrition prevailing in several countries. The beneficial effects of providing supplementary milk diets on the health and mental alertness of school children as well as the vigour and efficiency of factory labourers have been demonstrated by nutritional and public health research workers. In all progressive countries of the world, therefore, foremost attention has been given towards securing an adequate supply of milk to the population and the whole business of milk production, marketing and utilization has been developed into a great national industry embodying the latest advances in scientific knowledge. On the one side, extensive propaganda is being carried on for educating the people on the need for increased consumption of dairy products in their daily diet, while on the other side organized efforts are being made for improving the production of milk and safeguarding its healthfulness and wholesome food value with a view to enable the people to obtain more and better milk. As a result, there is now no branch of human activity in which science has wrought more beneficial changes than in the production and marketing of milk, and milk hygiene constitutes one of the conspicuous developments in the science of public health.

Importance of quality of milk

In spite of the remarkable developments that have taken place in milk industry, the production of an abundant, safe and wholesome milk supply has been and still is attended with great difficulties. This is particularly noticeable in India, where the situation is recognized to be extremely unfortunate both in regard to the quantity as well as the quality of milk available for the nutrition of the people. The qualitative aspect of milk production is, however, of the greatest significance to the nation since, not only does it determine the volume of milk ultimately reaching the consumers in a good condition, but it is also vitally concerned in the maintenance of public health and the economic utilization of milk. The outstanding importance of milk as a human food is due to its peculiar physical consistency, its pleasing flavour and above all the highly nutritive constituents—the easily digestible fat, the rich animal protein of high biological value, the balanced salt content with the valuable minerals for bone formation, the lactose, and the vitamins so essential for growth and prevention of disease—which make up its unique composition. These very properties of milk, however, render the product highly variable as well as perishable in nature and easily susceptible to microbial infection. The food value of milk may be impaired through any change in its composition due to natural or other causes, and the milk may become contaminated with pathogenic organisms associated with several dreadful diseases of mankind and cause serious outbreaks of epidemics, or it

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may become unfit either for human consumption or for manufacturing purposes as a result of bacterial activity. Thus the quality of milk as a food and as an article of commercial value may be enormously affected by any of the above factors. It is necessary to have a proper appreciation of their relative importance in this respect and the manner in which the intricate problems connected with the organization of milk industry have been solved in some of the Western countries, which are now highly advanced in this field, in order to understand the causes responsible for the poor state of milk production in this country and to formulate suitable measures for its improvement.

The most essential properties of milk which go to determine its value and safety for human nutrition, its marketable quality and its suitability for conversion into other edible products are (i) normal chemical composition and good flavour, (ii) freedom from physical impurities, adulterants and preservatives, (iii) bacteriological cleanliness and long keeping quality, and (iv) safety or freedom from disease-producing organisms.

Composition and flavour

In the first place, the food value and wholesomeness of milk for human consumption may be seriously affected by an alteration in its chemical composition, physical consistency and flavour. It is well-known that these are subject to certain natural variations, the most important of them being the species of the animal, climate and environment, breed and individuality and physiological disturbances associated with the normal cycle of lactation. Of greater importance to public health and which can be controlled by man are the changes due to improper feeding and management, diseases of the animal, subsequent treatment of milk after its production, e.g. adulteration and heating, and finally action of micro-organisms.

Feed and management

Animal nutrition workers have shown that there is a close relationship between the composition of the animal diet and the value of milk as a human food and that inadequate feeding results in lowered milk yield, variable fat content and other changes in the composition. The vitamin A potency of milk which is so necessary for the young children, is also influenced by the carotene content of the diet. Accordingly, for securing milk with sufficient 'protective' properties, the importance of grazing and providing green fodder and of including in the diet a sufficiency of vitamins A and D and other essential substances through a judicious selection of feeding materials has been realized. It is also common knowledge that any lack of care in the management of the animal, method of milking, interval between milkings and other conditions are immediately reflected in the quantity and quality of milk yielded apart from the effects of such practices on the health of the herd, and sanitary atmosphere in the byre. There is sufficient amount of scientific data available for guidance in the proper feeding and management of animals and full advantage has been taken of them in improving the quantity as well as quality of milk production in the more advanced countries.

Physiological or pathological abnormality

The alterations caused in milk as a result of any physiological abnormality or diseased condition of the udder are far more serious than those due to the other causes mentioned in the preceding paragraph. Thus colostrum and advanced lactation milk considerably differ from normal milk in their composition and they may be associated with high cellular content derived from the animal. Milk from diseased udders (particularly when affected with mastitis) is usually characterized by a high alkaline reaction, low solids-not-fat, low calcium and casein values, high globulin and chloride contents as well as presence of excessive leucocytes and other cells. There is some evidence that the vitamin content of milk is also lowered by mastitis. In serious cases, blood and broken down tissues may be found. Accordingly, milk associated with any of the above abnormalities is not considered desirable for either human consumption or manufacture of high grade milk products and it is essential that such supplies should be detected and eliminated from the market. In addition, mastitis is one of the most common and serious diseases of dairy cattle and is widely prevalent throughout the world. The consequent economic losses through lowered milk yields, alteration in the quality of milk and even loss of the animals are enormous and the regular detection and eradication of the disease should therefore form an indispensable feature in dairy herd management.

Adulteration

Adulteration of milk with water and other substances is extensively practised, with the result that the proportion of the milk constituents is seriously altered and the food value of milk lowered. Such changes caused in milk by the artificial manipulation of man are controlled by imposing strict legal standards and preventing the sale of sub-standard milks. The legal standards prescribed for grading milks in various countries are mainly directed towards fixing the limits of fat and solids-not-fat contents, which are the least affected through the mediation of natural causes. Similarly standards for fat and solids-not-fat have been prescribed in some of the provinces and States of India, although they vary from place to place and the position is complicated due to the existence in market milk supply of two types of milk—cow and buffalo—and their mixtures in various proportions.

Effect of heat

Milk is subjected to some form of heat treatment—sterilization, boiling or pasteurization—with the object of rendering it safe and prolonging its life. Of these, pasteurization of milk is most commonly practised in commercial milk handling, while boiling is generally followed in the consumer's house. The heating of milk to high temperatures may, depending on the temperature and time of holding, exert an effect on the acidity, hydrogenion concentration, coagulation, viscosity and tendency of calcium salts to separate and also cause caramelization of lactose, protein denaturation and alteration in flavour. The pasteurization temperature and time now commonly employed are not however sufficiently high or long to bring about changes of consequence in any of these physical and chemical properties of milk. It has also been shown that pasteurization has no deleterious effects on the vitamin content of milk with the exception of vitamin C and to some extent of vitamin B_1. The loss of vitamin C is not, however, a serious factor since milk is not a rich source of this vitamin and it is usually supplemented from other foods in the diet. Most of the experiments where raw and pasteurized milks have been fed along with other articles of diet have also proved that there is very little difference in their nutritive qualities. According to recent evidence, the nutritive value of milk is likewise not appreciably affected by a quick boiling of milk. Even granting that the nutritive value of milk suffers to some extent as a result of heat-treatment, however mild it may be, the loss is more than compensated by the advantages gained in rendering the product safe for consumption and in preventing its total destruction as a food within a short time.

Flavour defects

Milk associated with any unpleasant flavour is not liked by many persons. Children are particularly sensitive to off-flavours. Apart from certain variations due to individual animals, feed is one of the most common sources of abnormal flavours, e.g. corn silage, alfalfa, clover, turnips, onion, garlic and certain pastures and vegetable by-products. Flavours may be absorbed by milk during its production and storage near strong smelling materials, e.g. onions, turnips, fruits and vegetables, paints, kerosene, etc. When cows are affected with udder diseases or are in advanced lactation, the taste may become unpleasant, usually salty. Occasionally rancid odours may develop in milk due to spontaneous lipolysis of fat caused by lipase (an enzyme present in milk), particularly when the animal is in advanced lactation. Rancidity may also be induced by homogenization, shaking or other physical causes. Rancidity as well as other objectionable flavours like fishiness, maltiness and soapiness, may be caused by bacterial action. An oxidized or tallowy flavour may develop in milk as a result of its contact with certain metals, usually copper or copper alloys, or exposure to sunlight. Accordingly, the preservation of the natural pleasing qualities of milk is possible only if proper procedures are adopted in the production and handling of milk.

Bacteriological cleanliness

Milk should be clean if it is to be considered fit for human consumption as well as desirable from an aesthetic point of view. Cleanliness in general implies freedom of the milk from extraneous matter (dirt, hair and manure particles), from blood, from an undue number of leucocytes and from bacterial infection. The presence of physical impurities like mud and cowdung indicates extreme carelessness on the part of the producer and is calculated to bring down the market value of the product. They are either prevented from falling into milk by observing ordinary rules of cleanliness in the production and handling of milk or removed by means of simple filtration. The occurrence of blood and excessive pus cells in milk denotes a serious pathological condition of the udder due to mastitis or other causes, but this is not quite common. Such milk is obviously unfit for use. It should not be mixed with other lots of milk and the animal concerned must receive the immediate attention of the veterinarian.

Sources of contamination

Bacterial contamination is, however, the most important factor, since milk forms an ideal pabulum for bacterial growth and is continually subject to infection at all stages of its handling. It may, therefore, become highly contaminated with undesirable micro-organisms affecting its cleanliness, composition and useful period of life. Milk from normal healthy udders usually contains few organisms (less than 200 colonies per ml.) which contribute but little to the spoilage of milk. If, however, the udder is diseased due to infection by mastitis and other organism, the contamination may attain serious proportions (above 2,000 and occasionally going beyond 500,000 colonies per ml.) in addition to the large numbers of leucocyte cells which would accompany the abnormal milk. However, the main sources of initial infection are generally unsterile utensils, caked mud and manure on the cow's udder, dirt on the milker's hands, dust in the cow shed and the fore-milk in the teat canal, of which the untensils generally contribute the maximum contamination. The subsequent contamination may occur at any stage of its handling in the dairy, during transport or distribution and the initial numbers of organisms may reach tremendous proportions if milk is not promptly cooled and stored at low temperatures. A relative idea of the magnitude of infection contributed by some of these sources can be obtained from the data, given in Table I, collected at the Indian Dairy Research Institute, Bangalore.

From a qualitative point of view, cow manure sticking on the udder and flanks or splashings from fresh droppings are to be regarded as serious sources of contamination since several intestinal types, e.g. coliform bacteria and anaerobic spore-formers, which play an active part in the deterioration of milk and its products, as also many pathogenic and food poisoning organisms originate from them. Dust is considered to be a minor factor, but in tropical countries where the atmosphere will be heavily surcharged with dust particles, often laden with moisture, it assumes great significance and introduces many heat-resistant types, e.g. micrococci and aerobic spore-formers, which bring about the spoilage of heated milks.

TABLE I

Bacterial contamination in milk from various sources

Sources of contamination	Bacterial content (Plate count per ml.)	Methylene blue reduction time		Coliform bacterial present
		Hours.	Minutes.	
Normal healthy udder	Below 500	..		..
Mastitis udder	2,000 to 5,000 (occasionally up to 50,000 or more)	..		..
Clean byre	4,000	12	20	..
Unclean byre and dusty conditions	720,000	2	12	1/100
Washed udder	5,200	11	5	..
Unwashed udder	480,000	3	28	1/100
Washed hands	4,200	12	5	..
Unwashed hands	198,000	5	45	1/10
Foremilk rejected	4,800	12	12	..
Foremilk not rejected	178,000	5	49	1/10
Sterile milking pails	5,700	11	18	..
Unsterile milking pails	1,020,000	1	40	1/1,000

Following production, milk may receive further contamination at any stage of its handling in the dairy and during its journey from the cowshed to the distributor or to the consumer, depending on the cleanliness of the plant and utensils used for handling milk, conditions of transport, atmospheric temperature, humidity, etc. The distributor in his turn, by the use of dirty utensils and dirty bottles, can add considerable contamination to the milk. The initial numbers of organisms which enter milk in the above manner may soon reach serious proportions if it is not promptly cooled and stored at low temperatures or suitably processed. Some data obtained in our Institute illustrate the position quite well. These are given in Table II.

TABLE II

Variation in the bacterial counts of milk at different stages of handling

(Plate count per ml.)

To start with	Milking pail	9,500
	Weighing pail	16,000
	Bulking can	88,000
	Mixed bulk milk before pasteurization	330,000

Raw milk		*Pasteurized milk*	
Before despatch	8·6 ml.	Milk from heat exchanger	600
At the time of delivery	22·5 ml.	Milk from cooler	3,400
		After bottling (before despatch)	80,000
Returned undelivered	36·8 ml.	At the time of delivery	132,000
		Returned undelivered	151,000

Finally the consumers are not always free from blame in this respect. Dirty receptacles and unsuitable storage places add a fresh quota of organisms. The practice of leaving milk uncovered, to be contaminated by flies, is too common and is often a dangerous source of disease infection.

Milk may, therefore, appear physically clean and yet harbour a multitude of invisible organisms derived from various sources, which will find favourable opportunities sooner or later for active development leading to undesirable changes in milk as well as its ultimate spoilage as human food. The extent of such infection depends on the standard of hygiene and amount of care exercised in the production and handling of milk. The contamination is generally higher in summer and at the break of monsoon. Carelessly produced milk will invariably be associated with excessive bacterial counts (running into millions of colonies per c.c.) and large numbers of coliform and other taint-producing organisms which not only shorten the useful 'life' of milk but also cause off-flavours and introduce other defects into the products which may be manufactured from such milks. Such milks are also likely to contain some of those toxic substances of bacterial origin, which have an irritating effect on the gastro-intestinal tract, particularly of infants. These bacterial toxins are mostly stable and withstand any subsequent heat-treatment of milk even though the organisms themselves are killed.

Keeping quality

The keeping quality of milk, which refers to the length of time it will remain sweet and free from odours and taste that render it unpalatable and which is the most important attribute of milk desired by everyone, is seriously affected by bacterial activity. Since it is essentially governed by the metabolic activities of micro-organisms, the number and types of bacteria present in milk as well as the temperature and time of its storage determine the keeping quality.

Influence of temperature on keeping quality

The importance of temperature of storage and the extent of initial contamination on the keeping quality of milk will be made apparent from the following comparative data.

TABLE III

Influence of initial contamination and storage temperature on the keeping quality of milk

Source of milk	Initial contamination (Plate count per ml.)	Keeping quality (positive boiling test)		
		17·5°C.	22°C.	30°C.
		Hours Minutes		
Certified milk (England)	2,300	62 10	..	27 4
Farm milk (England)	75,000	36 42	..	18 0
Farm milk (Indian Dairy Research Institute)	231,000	..	18 0	11 0
Bulk milk (Indian Dairy Research Institute)	323,000	..	18 0	10 0
Village milk (Bangalore)	881,000*	..	16 0	8 30
Private dairy (Bangalore)	31·2 ml.*	..	5 0	3 0

Nature of spoilage

Among the various milk constituents, lactose forms the most easily available source of food for the micro-organisms. Accordingly souring of milk and acid curdling (accompanied by the production of gas and off-flavours if coliform

* Coliforms and streptococci very numerous.

bacteria are active) caused by the lactose fermenting types, which can grow very fast at ordinary atmospheric temperatures (20° to 40°C.), is the most common complaint. 'Sweet curdling' of milk is another familiar phenomenon (particularly in India) due to the action of aerobic spore-forming bacteria which are endowed with powerful proteolytic enzymes. The latter organisms resist even boiling and are generally responsible for the spoilage of heat-treated milks. In the case of Indian raw milks, a mixed type of fermentation is generally observed due to the preponderance of certain acido-proteolytic micrococci and other organisms. Most of them are heat-resistant and survive pasteurization. Thus the preservation of milk from deterioration is a difficult problem and serious economic losses to the industry and loss of nutrition to the people are occasioned by the premature spoilage of milk. The efficacy of any heat-treatment in prolonging the keeping quality is determined by the magnitude of heat-resistant flora present in it and the temperature of storage.

Milk and disease

Human diseases conveyed through milk : Milk can act as a potential carrier of disease germs endangering the safety of the consumers. Several diseases of man like tuberculosis, typhoid, paratyphoid, diphtheria, dysentery, septic sore-throat, scarlet fever, food poisoning or even cholera, may be spread through milk if it becomes contaminated by infected persons or carriers or through excretal material and contaminated water. Outbreaks of human diseases spread through milk are quite familiar. Reports are current from almost every country in the world regarding the frequent incidence of epidemic soar-throat, diphtheria and other milk-borne diseases, but it is difficult to ascertain their true extent and the actual destruction they bring about. It is reported that there were 103 milk-borne outbreaks of diseases in England and Wales between 1912 and 1935 involving about 12,000 persons. According to a report of the United States Public Health Service, 639 milk-borne epidemics of human diseases occurred in the United States during the years 1923-1937, involving 25,863 cases and 709 deaths distributed in the manner shown in Table IV. Sporadic cases of illness caused by infected milk or diseases like bovine tuberculosis, undulant fever or infantile diarrhoea are not included in the list.

TABLE IV

Incidence of milk-borne diseases in the United States during 1923-1937

Name of disease	Number of outbreaks	Number of cases attended	Number of deaths
Typhoid fever ..	369	6461	486
Septic soar throat	75	9467	117
Scarlet fever	84	5275	52
Dysentery and enteritis	34	1506	26
Paratyphoid fever	23	1029	22
Diphtheria	13	179	4
Miscellaneous diseases including food poisoning	41	1496	2

Diseases of cattle : A few diseases of cattle, too, can be transmitted to man through milk when it is produced by infected animals, or when it is contaminated by faeces or uterine discharges of such animals or indirectly through flies, rodents and other agents carrying infected materials. So far as milk hygiene is concerned, the three most important diseases of cattle are tuberculosis, contagious abortion and mastitis. It is estimated that nearly 40 per cent of cows in dairy herds of England and Wales are affected with tuberculosis and probably about 0·5 per cent of all milch cows are suffering from tuberculosis of the udder and are, therefore, excreting tubercle bacilli in their milk. About 6 per cent of all deaths from tuberculosis of humans are ascribed to the bovine type and some 2,000 deaths, mostly among children, occur annually from this disease. Contagious abortion among cattle is very widespread and occasions serious losses through abortion, diminution of milk output and sterility of the infected animals. More than 30 to 40 per cent of samples of raw milk exposed for sale in England and Wales have been found to contain *Brucella abortus*, the causative agent of abortion in cattle and undulant fever (brucellosis) in man. The number of cases affected by undulant fever may come to about 500 per annum although the exact figures cannot be estimated. In the United States, between 3,000 and 5,000 cases of undulant fever have been reported annually during recent years, and it is estimated that the reported cases represent only one-tenth of the actual number of cases. Mastitis of the udder in both its acute and chronic form is one of the commonest infections in dairy herds throughout the world and constitutes a serious problem both from the hygienic and the economic points of view.

Several organisms may give rise to the disease including streptococci, staphylococci and corynebacteria, the most frequent one being streptococcus agalactiae which causes the chronic and contagious type of mastitis. The deleterious effects of mastitis on the quality of milk and the milk-producing efficiency of the animal have already been referred to. It has been generally accepted that *Str. agalactiae* is non-pathogenic for man. Of greater importance from the hygienic point of view, however, is the occasional occurrence of mastitis due to *Str. pyogenes*, which is essentially a human pathogen. Cows probably become infected with it from a human case of scarlet fever or septic sore throat or from a carrier. A number of milk-borne epidemics of scarlet fever and septic sore throat have been traced to infection of cows with this organism or related types. A staphylococcus infection of the udder, which is of quite frequent occurrence, may cause food poisoning, often leading to severe vomiting, diarrhoea and collapse. Infections with organisms of the Salmonella group are not infrequent in cattle. The microbes may occasionally be excreted in milk or gain access from animal or human faeces and cause acute gastroentiritis or food poisoning in man. Among the less important diseases of cattle, that may affect the milk directly or indirectly and render its use undesirable or even dangerous for human beings, are foot-and-mouth, cow pox, anthrax, tetanus, suppurative infections of the body and diarrhoea due to Johne's disease or other causes.

Milk-borne diseases in India : There are no statistics available regarding the incidence of milk-borne diseases in India, but it is possible that several cases of typhoid and diphtheria may be traced to milk acting as the source of contamination either directly or indirectly. Contagious abortion is widely prevalent among cattle and according to recent investigations carried out at the Indian Dairy Research Institute, Bangalore and the Indian Veterinary Research Institute, Mukteswar mastitis due to streptococci, staphylococci and other organisms may be quite frequent among Indian cattle particularly in the larger dairy herds. It is not clear how far milk derived from some of the affected animals has been responsible for diseases among the people, particularly infants. Possibly the universal habit of boiling the milk before consumption may have saved many likely victims. However, the ill-effects of toxic substances developed in milk as a result of excessive bacterial proliferation, which may remain potent even after heat-treatment, may be quite serious for the health of children.

Disease-infection through milk products : Occasionally, epidemics of diseases have been caused by dairy products other than milk. Thus a number of cases of typhoid fever, scarlet fever and septic sore throat and gastro-intestinal disease have been traced to the use of infected cream, cheese and ice cream. Ordinarily there is not much scope for any pathogenic organisms derived from milk to be present in pasteurized cream, butter, hard cheeses, condensed milk or milk powder. But infection from persons handling the products and exposure to contamination by flies and other agents can always be expected. The latter point is of particular significance in India where milk products like ice cream, *khoa, dahi* and other indigenous products are prepared under most unhygienic conditions and constantly kept exposed to infection in various ways. It may, however, be stated that the vast majority of milk-borne diseases throughout the world, particularly tuberculosis and undulant fever, is due to the consumption of raw milk or cream.

It is clear from the foregoing observations that the frequency of disease in cattle, the risk of contamination from human and other sources, especially when sanitary precautions are lacking during the production of milk, and the high susceptibility of milk to bacterial growth, all together conspire to render the consumption of raw milk potentially dangerous. Efficient pasteurization of milk, which is now widely practised in most of the Western countries, is no doubt calculated to render the milk safe by the destruction of pathogenic organisms present in it, but in the case of carelessly produced milks laden with countless numbers of organisms, no such treatment would be sufficiently effective. Furthermore, there is an appreciable percentage of people who still persist in using raw milk either ignorantly or deliberately, which clearly brings out the importance, firstly of obtaining milk from herds guaranteed to be disease-free, secondly of observing utmost sanitary precaution in the production, distribution, and transport of milk and thirdly of subjecting all milk to some form of effective heat-treatment before use.

THE CALIFORNIA CITRUS INDUSTRY*

By S. KRISHNAMURTHI

THIS paper is a result of personal observation and study of the distinctive features of the citrus industry in California. It is not in any way meant to be an exhaustive account of the citrus industry in California, but only a few features have been deliberately selected to serve as examples of how, under certain unusual conditions of climate, water supply, soils and the pioneering attitude of the growers and others connected with it, the industry has been built up.

Climate

One of the most important factors that has been to a large extent responsible in shaping the citrus industry in California is the unusual climatic situation under which it operates. California has different climatic zones within a single State and each zone influences the citrus industry in its own characteristic way. Geographically, there are five distinct general regions within the State where citrus fruit varieties are grown commercially. These reach from San Diego County in the south to Glenn County in the north. The following are the regions:

1. The coastal plain area of the Southern California counties of San Diego, Orange, Ventura and Santa Barbara, and the south-western part of Los Angeles County. This section is characterized by an equable climate, with cool summers, mild winters and a relatively high atmospheric humidity due to close proximity to the Pacific Ocean.
2. The interior valley areas of San Diego, Los Angeles, Riverside and San Bernadino Counties. These have hot, dry summers, bright days and cool nights.
3. The Coachella and Imperial Valleys. These have very little rainfall and have extremes of summer heat and dryness.
4. The Central California Section, in the San Joaquin Valley. This includes parts of Kern, Tulare and Fresno Counties.
5. The Northern California Section in the Sacramento River Valley.

These last two citrus regions (4 and 5) are climatically similar, with a summer of hot, dry air and long, clear sunny days, and with spring, fall and winter having prolonged periods of cold days, heavy dews and ground fogs. This makes altogether five geographic regions and four climatic zones.

Such a range of climate is responsible for many characteristics of the California citrus industry. The chief of these is the fact that with just two varieties of orange (Washington Navel and Valencia) and four climatic zones, tree-ripe citrus fruits can be shipped all the year round, a feature which is not so prevalent in any other citrus industry in the world.

Again, certain peculiar qualities of the citrus fruits of California are directly traced to the climate. The much advertised 'Sun-kist' colour of the California fruits has been proved to be due to the greater fluctuation between day and night temperatures in California. In contrast, witness the lack of colour in the oranges of Florida with its more tropical climate and less fluctuation of temperatures, requiring artificial coloration to compete with California fruits in the eastern markets of the United States. The same climatic factor is responsible for the higher concentration of juice and enough acid giving richness of taste to the California fruits. Also, witness the relative insipidity of the Florida oranges where, even though the quantity of juice is greater, the blend of acidity is lacking.

The sub-tropical climate of California is also responsible for the thicker skin. While one would consider this at first thought as a defect, not so with the Californian citrus industry, which has capitalized on the greater storage and shipping quality resulting from this. Thus altogether, the climatic responses of the citrus fruit in California provide that State with unique advantages over Texas, Florida and Arizona, the other important citrus regions of the United States.

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* The article has been written with the hope that it would be of interest to Indian horticulturists and growers.

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Handicaps

But the climatic situation in California is not entirely a blessing and Californian industry is at present seriously worried about the problem of small size which is directly traceable to its sub-tropical climate and resulting deficiency of heat. It has been scientifically established that the heat requirements of citrus are high. In Florida and Texas, on account of greater amounts of heat, the fruits mature by the time the next bloom appears, whereas in California, it takes 15 to 18 months and, at one period, there are two crops on the tree, cumulative effect of which also is to reduce the size of the fruit. This is a matter of grave concern, since Florida production, although unorganized, has outstripped the California production and size of fruit after all is one of the competitive factors.

One other handicap which climate has imposed on the citrus industry of California is the need for protection against frost. Such a protection is one of the major problems of the California citrus industry. Of the total 350,000 acres of citrus in California, more than one-third now has heater equipment, a second third dose not suffer from frost damage often enough to warrant heating systems, and in the other third the need for heaters is marginal. Four million orchard heaters are in service. There is scope for another million heaters to be added. One of the most efficient organizations with orchard heating equipment that I saw was the Azusa Foot-Hill Citrus Company, Azusa, Los Angeles County. This company own 500 acres of citrus ranch, about three miles long, with an almost fool-proof organization and equipment to meet any frost hazard emergency, consisting of their own meteorological station in the coldest part of the ranch, a heater crew to act immediately in an emergency, and an oil-storage and delivery system, all perfect in handling a frost situation however serious or sudden. The efficiency with which an emergent situation like sudden appearance of frost is faced, will decide the loss or gain of a whole crop of fruits in the particular season and may often decide the loss or profits of a whole plantation. The heating season is normally from 1 November to 1 March, the period between 15 December and 15 January being the more intense. The United States Department of Agriculture provides a Fruit Frost Service which gives weather forecasts on the radio from 15 November to 15 February. Orchard heating is expensive but it is made worthwhile, because it not only saves the fruits which otherwise would have been destroyed but it also enhances the price of the fruit at a time when the market does not have plenty of fruit. And it is estimated that one year's profits obtained on account of heating often makes up for the cost of ten years' heating. Citrus belongs to a semi-tropical group of plants of tropical origin and the fact that it has been made to grow as a great commercial success under a climatic stress such as exists in some parts of California is a high tribute to the originality and initiative of the citrus growers of that State.

Irrigation

Southern California, where citrus is mostly grown, is a semi-arid region with an average annual winter rainfall of 15 in. far less than is required for agricultural development. Supply of water for irrigation of citrus groves is thus of primary importance and efficiency in organization and utilization of natural water resources is intensely correlated with the prosperity of the citrus industry. From this point of view, Southern California stands as a great example of that efficiency in conservation of natural resources and its utilization.

The water conservation programme in Southern California consists of some thirty-five major installations. Since thirty years, conservation of all local supplies has been effected by dams or spreading grounds for all rivers. Most of the rivers in Southern California have no perennial water supply but the seasonal water in the rivers is dammed and allowed to penetrate special spreading grounds, where it is retained as underground water for utilization all the year round. All the way from the canyons to the point of delivery to the fruit-growers, there are features which combine to make the water supply go the farthest it can, with minimum of wastage. There are the large impounding dams from San Fernando Valley to Santa Ana Valley, there are the spreading grounds to penetrate and replenish the ground water, there are the stream alignment projects to guide the path of streams in the best possible direction, and there is the forest fire protection for watershed areas. It is estimated that 300 million dollars have up to now been spent for such conservation works

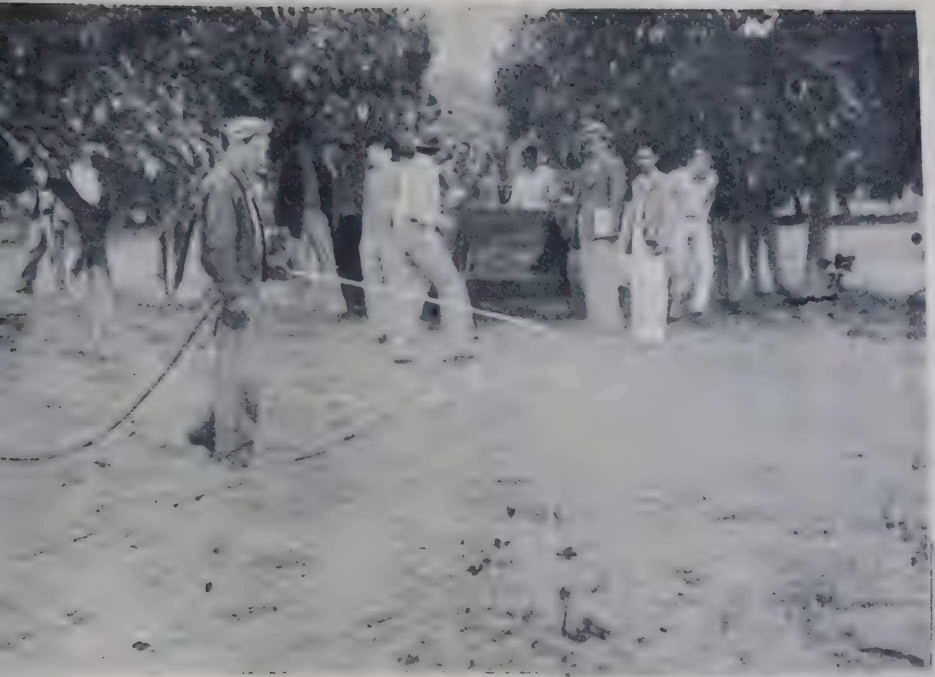
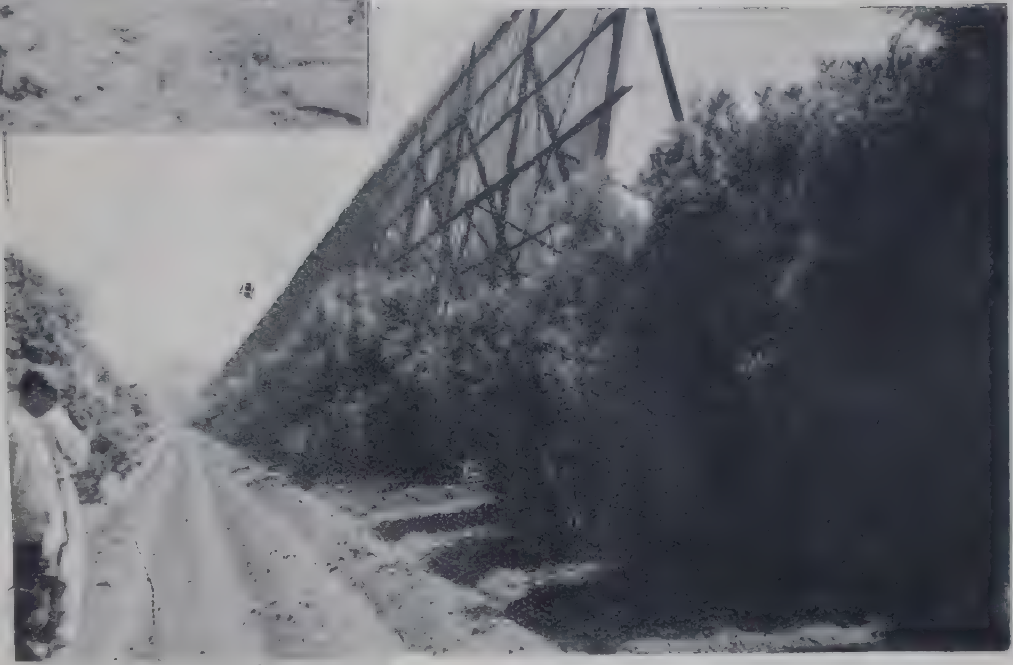


FIG. 1. Spraying oil as herbicide in clean non-tillage system of cultivation of citrus orchards in California.



2. Artificial lattice-wind-breaks for citrus groves of Mr. T. P. Breslin, Villa Park, Orange County, California.

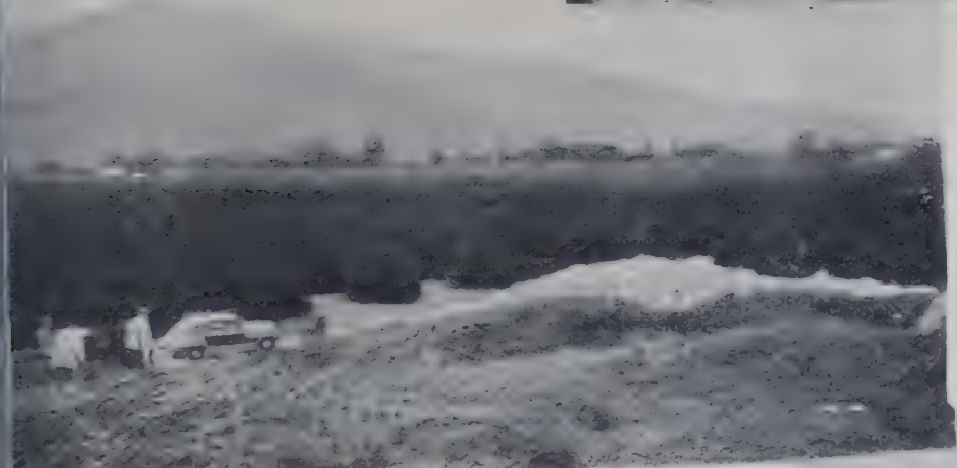
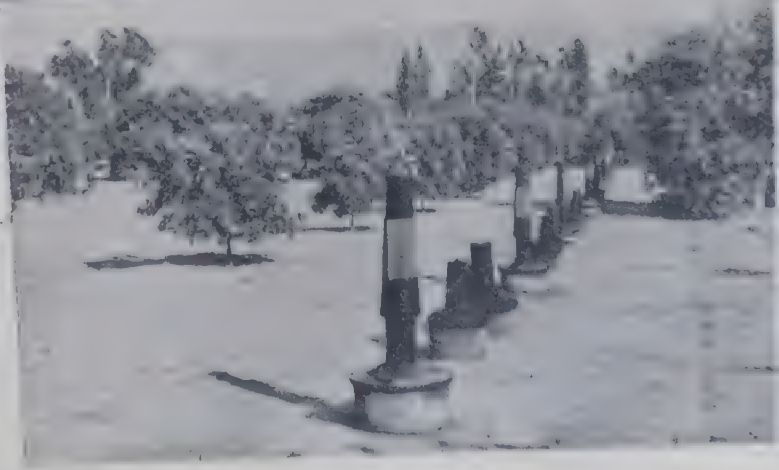


FIG. 3. Rocky soils for citrus in upland, in San Bernardino County (California). (See the pile of collected rocks)



4. Different types of orchard heaters to protect citrus orchards against frost-hazard in California.

and it is expected that another billion dollars will be spent in the future.

The unique range of variation in cost of water in Southern California from three or four dollars (about Rs. 10 to Rs. 13) to 30 or 40 dollars (Rs. 100 or Rs. 135) per acre is an indication of the ease or difficulty of obtaining water supplies and of the water as a limiting factor in citrus cultivation in Southern California.

The two principal sources of irrigation in Southern California are the two rivers, San Gabriel River and Santa Ana River.

With all these water resources and conservation methods, however, the rapid growth of Southern California has necessitated drawing upon underground water supplies, which had accumulated during a very long period estimated at thousands of years, to such an extent that at the present time withdrawal from the underground basins exceeds the replacement of the water by 200 million gallons of water each day. This is in spite of the fact that since 1913, Los Angeles city has been importing the major portion of its supply through its 238 mile aqueduct from the Owens River. Therefore, to provide abundant water supply for both present and future, the Metropolitan Water District of Southern California, whose water treatment plant at La Verna I had the pleasure to visit, has built one of the largest water supply systems in the world. It brings water to Southern California from the Colorado River, the last remaining source of supply for large importations. Its aqueduct extends over the entire State of California and is capable of delivering one billion gallons of water per day. The aqueduct, including Parker Dam, five giant pumping stations, reservoirs and miles of tunnels, canals, conduits, and siphons is one of the greatest construction projects at present. The hardness in Colorado River water averages about 300 parts per million, consisting mainly of calcium bicarbonate, calcium sulphate and magnesium sulphate. There is little boron. For these reasons, this water is suitable for agricultural purposes, including citrus.

Soils

It is not the intention here to discuss at length the soils of California under which citrus is grown, except to state that citrus has been grown in California under a wide range of soils, though, as in other countries, soils of good depth and medium texture, without any salinity are the best. But what is of unusual interest is the success that some growers have made out of certain adverse soil conditions, which would have been given up as hopeless by most citrus growers.

Utilization of rocky soils : One example was the utilization of rocky soils which I saw in Upland in San Bernardino County which is famous for its high quality and yields of citrus. It was a sight to see from a vantage point in Upland, wide stretches of rocky soils worthless for general agricultural purposes, but covered with citrus orchards in fine condition. The soil that I saw was a mixture of rocks, fine gravel, and plain sandy silt. This was sufficient proof for the opinion held by citrus workers in California that citrus, while highly intolerant of injurious chemicals or salts and of undue wetness of soil, which affects the high aeration requirement of citrus roots, does not require soils of great depth and fertility.

Such rocky soils, however, create difficulties in orchard management. For example, the first problem is of proper clearance of these rocks which vary from small stones to big. It is also difficult to form furrows for irrigation. The maintenance of moisture in the soil is another problem. Against these are set-off the advantages accruing from the good quality of water in this area and efficient drainage.

Reclamation of saline soil for citrus : Another example which I saw was the marvellously successful undertaking of reclaiming one stretch of 640 acres of saline soil for growing citrus, by Utt Development Co. Ltd., Oxnard, in Ventura County which is famous for both lemons and Valencia oranges. Prior to the purchase of this saline land by the company, not even sugar beets would grow and there was an instance of a meagre 1,100 lb. of barley straw being produced from 320 acres. During summer, salts formed a crust on the surface like snow. For all these reasons, the land value went down to the bottom and the company purchased it with the idea of putting enough money into reclamation. The company was helped in the reclamation work by the fact that the salts are soluble and so could be leached out by water. The land was purchased in 1930. Tile drains were built up every fifty feet, depth of the drain ranging from 7 ft. to $5\frac{3}{4}$ ft., depending on the gradient. At the time of laying these tiles, the water level was as high as $2\frac{1}{2}$ ft. from the surface. The tile drains led to a sluice flowing out to the ocean. The amount of salt that was in the soil could be guaged by the fact that during the first year, according to Mr. Newman, Vice-President and Manager of the company, 250 tons of salt went out of the drain every 24 hours, sometimes rising to 400 tons. In most of the area, in the beginning, alfalfa, well-known alkali-tolerant crop was planted. Frequently lima bean was also grown, as an indicator crop, as it has been experimentally proved that in a soil where lima bean is successfully grown, citrus could also be successfully grown. In 1930-1932, when tiling was done every 50 ft., the work was done rather cheaply and even then it cost $115,000 on tiling alone, costing $180 an acre (about Rs. 600). In 1943, they modified their method, by tiling deeper, 10 ft. deep and 350 ft. apart and it cost them $80 (about Rs. 270) an acre. The reclaimed area at present has 125 miles of drains of 6 in. to 14 in. size tiles. This company developed a tiling machine going 10 ft. below and laying the pipes with gravel at joints. All the tile lines come up to a water-head so that flushing can be done to see that the drains work freely without any clogging. The company found that sometimes during seasons of heavy rains, there was no free movement of water in the canal and the water would even back up. To overcome this, a centrifugal pump was used at the end of pipes to pump out the discharge.

Pioneers in new methods

What has been said before already records instances of the initiative and originality of citrus growers which has played a great part in building up the citrus industry in California. What is even more unique is the ever-increasing urge among the growers to experiment with new methods and new techniques. The following are some examples.

The clean, non-tillage system of soil management: This system in citrus groves was observed on the citrus ranch called Rancho Sespe, in Sespe, Ventura County. The authorities of this ranch have now an experience of ten years in this method. The practice followed consists of two essentials, viz. not to use any tillage implements to disturb the soil except the minimum disturbance that would be necessary for fertilizing and irrigating the land and to control the weeds by heater oil as a herbicide. Such a non-tillage system is said to get rid of some serious defects of the tillage system. For example, ploughing or tillage destroys the soil structure below the tilled surface and makes it impenetrable for water. Also, when tillage is done, the leaf droppings and the organic matter are decomposed and lost more quickly. In fact, in this clean, non-tillage system, no manure has been applied to the soil for eight years and no harm has yet been observed.

Fertilizer is applied in this system in either of two ways. In the sprinkler system of irrigation, the fertilizer is spread over the soil and the water sprinkled. In the case of furrow irrigation, permanent furrows are made for irrigation and fertilizers dissolved in the irrigation water.

Altogether the experience with the clean, non-tillage system has been so successful in this ranch that it has become quite a vogue with many growers now and it has been a centre of interest for many foreign visitors who come to study the citrus industry in California.

Permanent sod system of soil management: In this system, the ground is turned over to permanent sod, natural or planted, and there is no tillage at all. Very little of this system is practised in the citrus industry of Southern California. It has been tried by a few growers here and there but they soon got into trouble and ultimately took up the conventional standard tillage system or the clean, non-tillage system spoken of previously.

The lattice wind-breaks: That a live wind-break around orchards is basic to all fruit culture is well-known but that an artificial wind-break would serve the purpose for citrus was the idea of Mr. T. P. Breslin, Villa Park in Orange County. He constructed a lattice wind-break in 1939, 40 ft. high, with an angle to give a bend with the idea of offering less resistance to the wind. His ranch of 104 acres of citrus has 7 rows of such wind-breaks, each 1,800 ft. long with a spacing of 140 ft. between each. Each of the large wooden supports for lattice has a foundation of four cubic feet. It cost the owner a total of $2·50 per foot (about Rs. 8).

The following advantages are claimed for the artificial wind-break:

1. It is the quickest way of establishing a wind-break. If labour is available, one can have a wind-break within a month or two, whereas live wind-breaks would take seven years to attain this height, and during these

seven years, when a grower is waiting for the wind-break to come up, the losses could be severe.

2. Live wind-breaks are undoubtedly in competition with the main orchard trees and offer their own management problems and harbour undesirable pests. Artificial wind-breaks do not have these problems.

As against these, are also disadvantages of artificial wind-breaks. The cost of erection is high, but in a citrus region like Orange County with high returns, the costs are soon made up. The depreciation cost is bound to be high with a wooden structure of this kind, and the ultimate duration of this wind-break is yet to be tested.

Acknowledgment

I owe the opportunity of studying at first hand the California citrus industry to the Madras Government who deputed me for horticultural studies in the United States. I am grateful to Professor R. W. Hodgson of the University of California at Los Angeles for valuable advice and suggestions in the preparation of this paper.

D.D.T. AS DAM AND CHANNEL PROTECTOR

WATER conservation engineers, irrigation experts and farmers are interested in a report from Mr. L. J. Watson, entomologist stationed at Leeton, Australia, on the killing of carp (*Carassius* sp.) and yabbies (*Parachaeraps bicarinatus*) with D.D.T.

A Murrumbidgee Irrigation Area orchardist, who had been using a 0·1 per cent D.D.T. spray, drained his spray plant back into a dam of an estimated capacity of 25,000 gallons. Hundreds of carp and crayfish (or yabbies) were dead along the banks of the dam on the following morning, and were still being affected and dying 24 hours after the pollution. On the basis of figures quoted, the final D.D.T. concentration in the dam would be 1 in 25,000,000.

Yabbies burrow into and weaken the walls of earth dams and irrigation channels, which then collapse. Consequently cement surfacing has had to be used in many irrigation areas. This experience with D.D.T. suggests a possible method of controlling the nuisance.—*Australian Agricultural Newsletter*, Release No. AGN/193.

JAMNAPARI GOATS

By M. R. MAHAJAN and A. A. KHAN

OF the Indian goats, the Jamnapari is the most distinctive and profitable breed. This breed is famous for its majestic beauty and usefulness throughout the country, but, it is only in the United Provinces, the original home of this breed, that some systematic improvement work has been undertaken. This note contains observations pertaining to distinctive characters of the breed, its habitat and the development scheme in progress in these provinces.

Habits and habitat

Open 'barn' system of flock-keeping on dry lands with ups and downs agrees admirably with the Jamnapari goats. Like other goats they love grazing, but require constant change of pasture; they like coarse grass but not of the rank type. The kind of herbage they prefer most, is the short sweet pasturage on down and dry commons. On these, they have the advantage of changing over from the grass to the sweet tender shoots of trees and shrubs of which they are extremely fond; these latter also contain a considerable amount of nutrients. The Jamnapari goats enjoy grazing but prefer browsing on leaves and shoots of *babul* (*Acacia arabica*), *chenkur* (*Bosopis spicigera*) and *karil* (*Capparis aphyla*) and many other local shrubs like *heense* (*Capparis horrida*), *makoh* (*Zyzyphus oenoplia*), *inni* (*Cholere dondar*).

These goats are occasionally also fed on concentrates consisting of husk and *chuni* of *jowar* and *arhar*, *sanai*, *maize*, gram and *bajra* in quantities varying from ½ to 2 lb. per day according to age and size. Salt is also sometimes given.

The breed thrives best in the dry climate of ravinous areas, but can easily adapt itself to any other place, having similar climatic and grazing conditions.

The breed derives its name from its natural habitat in the ravines on the western banks of the Jamna. These ravine tracts comprise of the trans-Jamna and trans-Chambal areas in Etawah District in the United Provinces and the adjoining northern parts of Gwalior State. Chakkarnagar, a village about sixteen miles south-west of the town of Etawah in the United Provinces and situated in the ravines of the river Jamna and Chambal, can be taken as the centre of the home tract of this breed, and true specimens are met with there and in the surrounding territories in large numbers.

The goats found in the trans-Chambal areas are superior in quality and milk yield to those found in the trans-Jamna tracts. The drinking of Chambal river water containing iron is commonly believed to be responsible for giving a glossy and shining coat to these goats.

Breed characteristics

This breed is fond of roaming about in open pastures for miles together. It is essentially a 'wandering' village type needing plenty of exercise. In this respect it is in complete contrast to Barbari breed which is essentially a homely urban type.

The goats of the Jamnapari breed possess wide pendulous ears (about 14 in.), a bow-shaped Roman nose and are tall and leggy. The horns are upright and often spiral, though in some cases they closely recumbent on the head. There is a beautiful tuft of hair on the forehead. The hair on the body, excepting the chest and the thighs, are very short, beautifully sleek and glossy. In both the sexes, the thighs are covered with long, fine and shining hair and a short woolly undergrowth between them. The bucks have a shaggy beard and well-developed, broad chest covered with thick tuft of hair. The majestic appearance and the haughty bearing of the Jamnapari buck is a distinctive feature of the breed.

The colour varies from white to black and white or red and white; often the coat is light or dark fawn-coloured with a black line along the back and black points on legs (generally in males).

The live-weight of a full-grown male goat ranges from 150 lb. to 235 lb. and that of a

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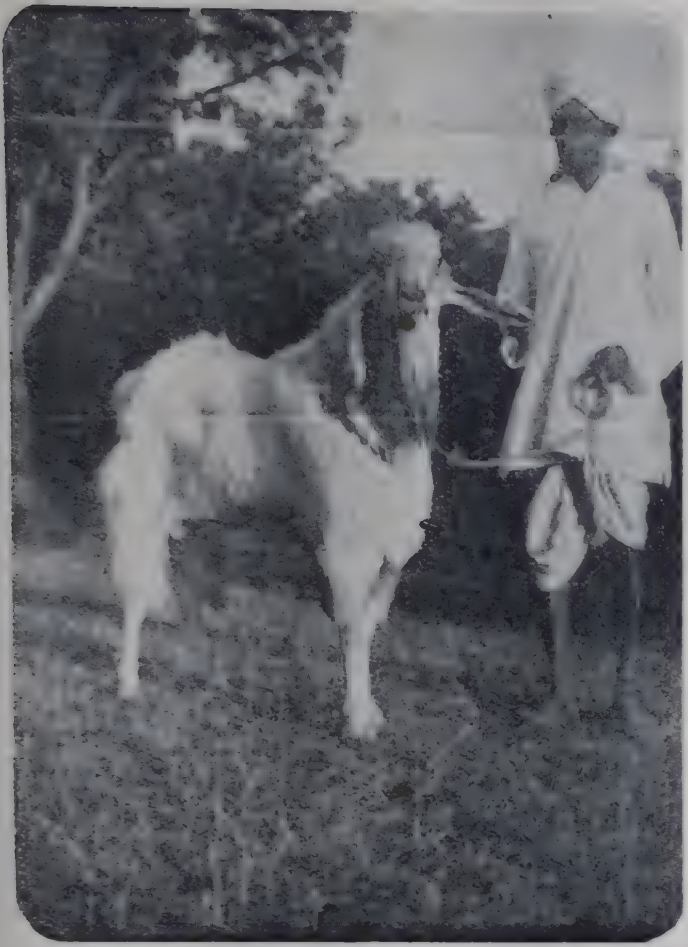

FIG. 1. Jamnapari buck.

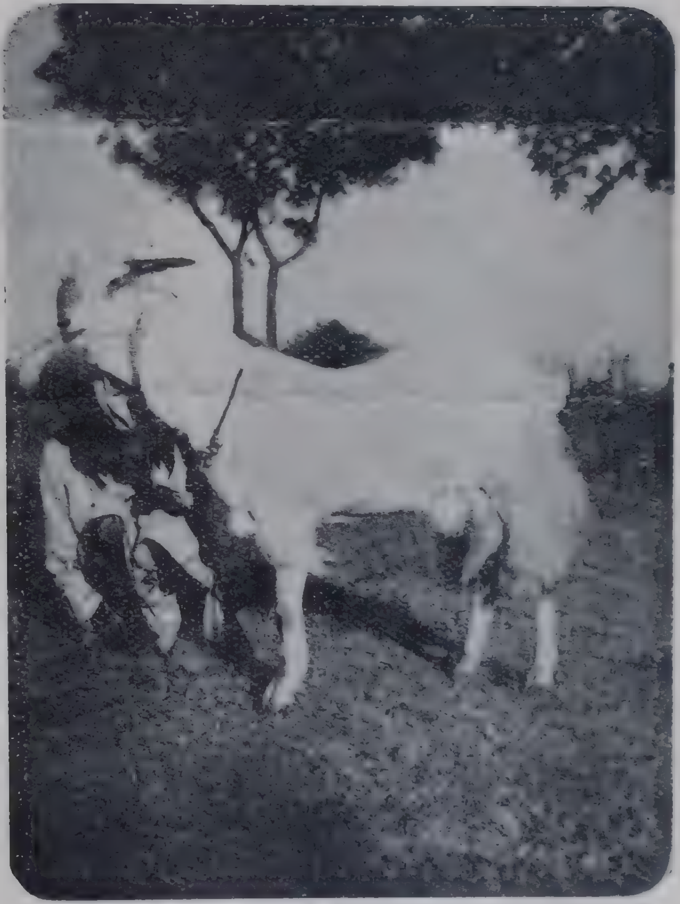

FIG. 2. Jamnapari she-goat.

FIG. 3. Jamnapari flock.

female from 80 lb. to 130 lb.

Body measurements are as follows :

Height at withers	40 in.
Girth	45 in.
Length	43 in.
Length of hair tuft on back of thighs	21 in.

The breeding season is usually in the months of June and July. The breeders exercise strict control and no mating is allowed till the age of about two years when both the sexes are fully mature. They sell out the surplus males at an early age. They are careful to select the best male even if it happens to be eight to ten miles away.

Under village conditions, unlike other type of goats, kidding in this breed takes place only once a year giving birth to a single kid as a rule.

The period of lactation is about six months. The female goats are splendid milkers carrying immense udders with long teats. The average yield of good milkers varies from six to eight pounds per day.

Development scheme

The American Mission at Etah was the first to bestow attention to the development of the breed. This Mission purchased and exported about one thousand heads of excellent goats from Chakkarnagar area to Java between 1924 to 1938. The demand for Jamnapari goats has since grown in India, China, South Africa and Tibet.

The Indian Council of Agricultural Research in 1935 provided funds to the Mission at Etah for the improvement of these goats. The Mission for a time instituted shows and purchased and distributed bucks. A breeding station was also started at Etah, which was later transferred to Agricultural Institute, Allahabad.

In 1938, at the instance of Dr K. N. Katju, the then Hon'ble Minister of Agriculture in the United Provinces, the Veterinary Department surveyed the breeding tract and submitted the present 'Jamnapari Goat Improvement Scheme' with a view to preserve and develop the breed.

The Scheme sanctioned by the Provincial Government in 1938 is calculated to encourage breeding, development and preservation of these goats in villages of its home tract. This is done through supervision and control by the departmental staff of all breeding stocks, by grant of subsidy to those who maintain standard specimens, by purchases at attractive prices of surplus males by the Department for breeding in other tracts, by allotment of handsome prizes at the annual shows and by strict control of export of goats from Etawah District.

To encourage production of better milking strain the yield of milk was adopted as the basis of granting subsidy from 1946. Besides the above, a flock at Agricultural Institute, Allahabad, is also subsidized by the Provincial Government to produce bucks for distribution by the Animal Husbandry Department.

In the Chakkarnagar area, the Scheme has produced excellent results; the height, live-weight and milk yield have all increased in recent years. The prices fetched at the annual shows by the sale of bucks are considered to be sufficient impetus for maintaining the high standard of bucks in this area. The subsidy scheme may well be extended to other areas in the neighbourhood.

Subsidy

The payment of subsidy is half-yearly, Rs. 3 for male and Rs. 2 for female per month. The condition entails tatooing of subsidized flock and its progeny. They are not to be sold except after refusal by the Department.

Table I gives the data relating to the subsidized goats, the amount of subsidy and the purchase of bucks in recent years.

TABLE I

Number of subsidized goats, rate of subsidy, etc.

Year	Goats under subsidy		Rate of subsidy per month		Bucks and goats purchased from the tract
	Bucks	Goats	Bucks	Goats	
1944-45	27	137	Rs. 3 each	Rs. 2 each	85
1945-46	19	117	,,	,,	133
1946-47	26	129	,,	,,	104

Goat shows

An annual show is held at Chakkarnagar usually in February or March. Excellent specimens are brought to this place for competition. Cash prizes worth Rs. 500 are awarded by the Provincial Government. The All-India Cattle Show Society have accepted this as a regional breed show and contribute Rs. 104 for prizes. This breed has also figured at the All-India Cattle Show, Delhi and has won recognition and prizes.

Prices

The cost varies according to the market fluctuations and also depends on the quality and age of the animal. A full-grown female of a renowned lineage having good milking characteristics may cost Rs. 100 to Rs. 200 and the male goat from Rs. 50 to Rs. 100, whereas the kids of both these sexes may cost Rs. 40 to Rs. 60 and Rs. 15 to Rs. 35 respectively. Goats of ordinary classes, both male and female, may be had from Rs. 30 to Rs. 80 and kids from Rs. 10 to Rs. 30 per head.

Development policy in the province

The policy now laid down for the development of goats in the United Provinces is to develop the Barbari breed for augmenting milk production in urban areas where these goats can be maintained with ease and economy. In the hills, efforts are being made to help meet the local demand for 'pack' goats and for these areas Kangra Valley type of goat is being favoured. For the plains, the policy is to issue the Jamnapari buck to help improve the village *desi* stock to produce more milk and mutton. Most of the so-called *desi* village goats found in most parts of rural India and indeed in the United Provinces, and reared for mutton and milk, are degenerated strains of the Jamnapari breed. This observation appears to find support from the fact that the Beetal and Daira Din Panah breeds, reared in other parts of India for improving the local stock, may be said to be the near off-shoots of the Jamnapari breed.

Mode of supply from the district

Jamnapari stud bucks are lent to improve the *desi* breeds within the province in accordance with the 'Rules of the Animal Husbandry Department, United Provinces' on a nominal contribution of Rs. 5 per head.

A limited number of she-goats and bucks are also supplied at cost price to interested breeders with the approval of the Department.

The goats for supply are selected by the District Livestock Officer stationed at Etawah from amongst the stock in Chakkarnagar area and are transported by road from there to Etawah for export outside the district.

The average size of a well-developed and a full-grown Jamnapari goat is usually above 30 in. Goats below 30 in. only have so far been transported in dog boxes attached to the passenger trains, as those above this height cannot be booked for want of suitable transport accommodation. This point has in a way acted as a deterrent in exporting the best developed stock outside the home tract.

The transport charges by road from Chakkarnagar to Etawah including feeding and attending charges amount approximately to Rs. 2-8 per head in case of consignments of more than one goat and Rs. 5 for a single goat. The railway freight when booked in dog boxes at owners' risk is 10 as. per fifty miles plus 2 as. per rupee as surcharge, per head of goats and kids.

Acknowledgment

The authors are indebted to Sardar Bahadur Udham Singh for photographs reproduced in this note and Mr. P. G. Pande, M.R.C.V.S. for help rendered in the preparation of the report.

IMPROVED VARIETIES OF TABLE RICES IN THE UNITED PROVINCES

By P. S. GUPTA and A. K. MITRA

THE survey collection of varieties revealed the richness of this province with regard to the table rices. Excellent table rices were found growing in scattered pockets all over the province, but they were little known outside the place of their cultivation. For example, *Duniapat* is confined to Basti, *Kala Sukhdas* to Banda, *Dhani* to Mainpuri, *Lavang Choor* to Mirzapur and so on. The best known are *Bansmati* of Dehra Dun and *Hansraj* of Pilibhit, which have given the United Provinces a high place as a fine rice-producing area in the country.

It may be noted that, as a rule, high yields and quality do not go together, but by means of judicious selection work over a long period it has been found possible to combine reasonably high yield with quality in the varieties that are described below.

Description of varieties

(1) *T*-3. (*a selection from* Bansmati *of Dehra Dun :* A medium early type, taking about 98 days to mature after transplanting; grains long and fine; L/B ratio 4·3; glumes straw coloured; awns present up to a length of 1 cm.; apiculus dull yellow; habit erect; plants grow fairly tall and lodge on rich soils; panicle long and lax, not dense; rice white, strongly fragrant and gives an attractive appearance on cooking; an excellent *pulao* rice. It should be transplanted early, i.e. by the middle of June to avoid *gundhi* (*Leptocorhiza vericornis*) attack. It is suitable for Dehra Dun, Saharanpur, Muzaffarnagar and Pilibhit districts.

(2) *T*.9. (*a selection from* Duniapat *of Basti*) *:* A late type; takes about 135 days to ripen after transplanting; grains fairly long and fine; L/B ratio 3·9; glumes straw-coloured with orange apiculus; awns absent; rice is white and fragrant with excellent cooking quality. It is good as ordinary rice, *pulao* and *zarda*. It may be transplanted by the first week of July. It is suitable for Mirzapur, Kanpur and north-eastern districts of the province.

(3) *T*.23. (*a selection from* Kala Sukhdas *of Banda*) *:* A late type; matures in 131 days after transplanting; grains fine; L/B ratio 3·8; glumes and apiculus reddish-fawn; awns variable, 1 cm. to 3 cm.; rice white, tastes well, fragrant; fragrance apparent even in the nursery and the field while the crop is green; reported tolerant to *usar* (alkaline) soils; a tendency to shed grains and should therefore be harvested before it is dead ripe; a good rice. It may be transplanted by the first week of July. It is suitable for *banda* and *usar* area of Hardoi and Unao districts.

(4) *T*.79. (*a selection from* Choti Parjati) : A late type taking about 128 days to ripen after transplanting; grains medium-fine; L/B ratio 3·4; glumes reddish brown; awns about 1·5 cm. in length; apiculus coloured; habit erect but plants lodge on rich soils; panicle long and well exerted; rice white, fragrant and of good cooking quality; a good table rice. It may be transplanted by the first week of July.

(5) *T*.26. (*a selection from* Anjee *of Basti*) *:* A late type taking 130 days to mature after transplanting; grains small and fine; L/B ratio 3·7; glumes straw-coloured usually without awns; but tiny ones may occur here and there; apiculus colourless; panicles long and heavy; rice white and of superior cooking quality; a good *pulao* and table rice. It may be transplanted by the first week of July. It is suitable for Basti, Bahraich and Mirzapur districts.

(6) *T.N*.10*B*. (*a selection from* Hansraj *of Pilibhit*) *:* A medium early type taking 100 days to ripen after transplanting; grains long and fine; L/B ratio 4·1; glumes straw-coloured with awns up to a length of one inch; apiculus colourless; habit erect and the plants lodge in rich soil; panicle long and lax; rice white,

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fragrant and of good cooking quality; an excellent *pulao* rice. It should be transplanted by the middle of June to avoid *gundhi* attack. It is suitable for Dehra Dun, Saharanpur, Muzaffarnagar and Pilibhit districts.

(7) *T.5.* (*a selection from* Hansraj *of Gonda*): A late type taking 135 days from transplanting to maturity; grains medium long; L/B ratio 4·1; glumes straw-coloured; awns absent; apiculus colourless; rice white, fragrant and of good cooking quality; a good table rice. It may be transplanted by the first week of July. It is suitable for Gonda and north-eastern districts of the province.

(8) *T.*15. (*a selection from* Jarhan *of Barabanki*): A late type taking 135 days from transplanting to maturity; grains medium long; L/B ratio 3·9; glumes dark; straw-coloured with black purple mottlings; awns long, black purple in colour; apiculus black purple; rice white and of good cooking quality; and excellent *zarda* rice. It may be transplanted by the first week of July.

(9) *T.*105. (*a selection from* Dhani *of Mainpuri*): A late type taking 135 days from transplanting to maturity; grains small, roundish in shape; L/B ratio 1·8; inner glumes dull-coloured; awns and apiculus red purplish; rice white and strongly fragrant; a good table rice. It may be transplanted by the first week of July. It is suitable for Mainpuri, Bijnor and other western districts.

(10) *T.N.*12. (*a selection from* Suffeida *of Punjab*): A medium early type maturing in about 102 days after transplanting; grains long and fine; L/B ratio 4·4; glumes straw-coloured; awns ·5 cm. to 1·5 cm.; apiculus colourless; plants tall, erect and liable to lodge in rich soil; panicle long and exerted; rice white, fine, scented and of good cooking quality, specially suited for *pulao*. It compares closely with T.3 and T.N. 10B. It should be transplanted by the middle of July to avoid *gundhi* attack. It is suitable for Saharanpur, Muzaffarnagar, Dehra Dun, Bijnor and Pilibhit districts.

Yield of varieties

As noted already, the yield and quality in rice do not go together, and generally a 'quality' rice is a low yielder but this loss in yield is usually more than made up by the higher price it fetches. According to the report on the *Marketing of Rice in India* (1941) (page 204) fine rices fetch about double the price of bold rices in the United Provinces. The varieties that have been described above, however, combine reasonably good yields with high quality which has been brought about by judicious selection over a number of years. The expected grain yield (paddy) per acre for these rices is given in Table I.

TABLE I

Grain yield per acre in selected varieties of rice

Type		Md. per acre
T. 3	..	16
T. 5	..	24
T. 9	..	22
T. 15	..	22
T. 23	..	15
T. 26	..	24
T. 79	..	23
T.N. 10B	..	21
T.N. 12	..	19
T. 105	..	20

It will be seen from above that barring T. 23, T. 3 and T.N. 12, all others give over 20 md. per acre at the Rice Research Station, Nagina which should be regarded as reasonable.

Fineness

In the *Report on the Marketing of Rice in India* fine rices have been classified into two categories, e.g. 'Long fine' and 'Short fine'. It is also stated that fragrance is a much valued quality which is more often than not closely associated with this group of rices. We have seen above that all our improved table rices are fragrant. The quantitative fineness is judged by the grain length/breadth ratio. In the report (ibid) the U.P. rices have been classified, according to this ratio, as fine, medium and bold. The fine rices have a L/B ratio of 3·26 to 3·83, the medium rices from 2·04 to 2·94 and the bold rices from 1·93 to 2·35.

According to the ratio all our varieties except T.105 come within the fine group and most of them have a L/B ratio higher than that recorded as the maximum in the report. Though coming within the 'bold' category, T. 105 is an excellent table rice in other respects.

Milling quality

If yield, fineness and quality on cooking are important attributes of a table rice, its behaviour on milling or husking is no less so. Since paddy must be subjected to a process of hulling, either by hand or machine, before it is fit for consumption, its market value as well as its cooking value, must depend upon its hulling quality. A variety which breaks rather badly on milling (hulling) is neither desirable from the point of view of marketing nor from the point of view of cooking quality. It is a matter of every day experience that broken rice does not give a pleasing appearance on cooking as individual grains tend to run together and form a pasty mass depending on the degree of breakage.

Keeping these considerations in view the hulling quality of each of these varieties was tested with an Engelberg Huller. No polishing was however done. The quantity of whole grains obtained per maund of paddy of each variety is given in Table II.

TABLE II

Quantity of whole grains obtained in paddy after hulling

Type	Whole grains in seers obtained per maund of paddy hulled
T. 3 ..	19
T. 5 ..	21
T. 9 ..	23
T. 15 ..	22
T. 23 ..	24
T. 26 ..	21
T. 79 ..	22
T.N. 10B ..	20
T.N. 12 ..	19
T. 105 ..	26

It will be seen that the percentage of whole grains in our varieties varies from 47·5 per cent to 65 per cent finer rices giving lower figures.

Generally the percentage of rice obtained from paddy is reckoned as 66 or 2/3rd of paddy hulled (c.f. *Report on Marketing of Rice in India and Burma*) depending of course on the variety. The quantity of rice in relation to paddy hulled as given in the report (ibid), however, includes both whole and broken grains and apply to polished rices and not to shelled rice only as in our case. No precise information on the exact amount of whole grains obtained is recorded therein. Even then it would be quite reasonable to conclude that even the finest of our rices (T. 3 and T.N. 12) give a very satisfactory account of themselves in hulling.

The improved varieties of table rices described above therefore possess almost all the characteristics desired by a rice eater in his plate of rice, and it is hoped that their cultivation will be extended for the benefit of those who care for fine rice and are prepared to pay a higher price for it.

What the Scientists are doing

PERCENTAGE OF HAIRY SHEEP IN INDIAN PROVINCES

As in the case of many other figures relating to the statistics of production in India, no accurate and reliable data regarding the annual output of wool are available at present. Only a very rough estimate of the total production can be obtained by taking the product of (i) the total number of sheep in the country, and (ii) what may be called the average annual output of wool per sheep. Such an estimate is likely to be a very poor approximation of the true value owing to the fact that average yield of wool per year is not the same for all sheep, but varies not only from breed to breed but even within breed.

As a first step in the improvement of these statistics, it was suggested by the Advisory Board of the Indian Council of Agricultural Research that proper account should be taken of at least the hairy sheep found in some parts of the country, which do not produce any wool at all. For this purpose, it was necessary to obtain the percentage of hairy sheep in each of the various provinces and States.

In the absence of direct information regarding the number of hairy sheep in a province (a State), the procedure adopted to estimate the percentage was as follows. Estimates of the fraction of the total strength of sheep which did not produce wool at all were collected for all the districts of the unit from the District officials. Each such fraction, when multiplied by the total number of sheep in the district (which was available from the livestock census), gave an estimate of the number of hairy sheep in the district. These estimates were added together to obtain the estimate of the strength of hairy sheep in the unit as a whole. This figure was utilized along with the total number of sheep in the whole unit to get the required percentage. The estimates so arrived at are given below.

	Province or State	Percentage of hairy sheep
1.	Madras	85·4
2.	United Provinces	18·2
3.	Punjab*	17·9
4.	Central Provinces & Berar ..	30·0
5.	Bihar	23·7
6.	Hyderabad (Deccan) ..	19·1
7.	Mysore	38·3

As regards the remaining units, Bombay, Bengal, Sind, N.W.F.P., Kashmir and Baroda reported to having no hairy sheep at all in their unit, while Assam was reported as having cent per cent hairy type of sheep. Orissa and Bhopal sent overall estimates of the percentage of hairy sheep, reporting 30 per cent and 70 per cent respectively as the figures required.

It is difficult to assess the accuracy of the estimates obtained above as it is dependent on both the reliability of the census figures and the precision of the official estimates of the hairy sheep percentages in each district. Not only is there much room for improvement in the accuracy of the livestock census, but the method of assessing the district percentages, which appears to be that of shrewd guessing backed up with experience and knowledge of local conditions, needs to be replaced by an objective method of sample survey based on sound statistical principles. These limitations of the above estimates have, therefore, to be borne in mind in utilizing them in any manner. (V.N.A.)

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*The figures relate to undivided India.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. I have heard of the use 'Gammexane' for controlling insect pests of stored grains. Will you please tell me how this insecticide is used in godowns?

A. It is a well-known fact that one of the chief sources of infestation of foodgrains is the godown itself where grain has been previously stored. In such godowns insects remain lodged in cracks, crevices and depressions living on spilled grain or waste flour. Complete disinfestation by mechanical methods is difficult. Fumigation is an effective and reliable method of disinfesting godowns but for want of suitable structures and technical staff to carry out the operations this method cannot be recommended for general use. Besides, the cost factor is also a serious consideration. Experiments carried out by the Food Department on 'Gammexane' (666) smoke have given satisfactory results against stored grain pests (except khapra larvae). This method of treatment is, therefore, recommended for general use.

The material is supplied in the form of 1 lb. canisters. It consists of 'Gammexane' mixed with a substance which decomposes flamelessly on ignition and liberates heat. This heat volatalizes 'Gammexane' which is incorporated with the decomposible substance. The 'Gammexane' is given off in the form of fumes which disperse in the surrounding space. In using the canister the outside lid should be taken off and the scored lid underneath removed as indicated on the tin. On ignition, dense white fumes will be given off which ascend to the roof and spread out and settle in the form of a deposit on the floors and walls. The dose prescribed is one pound unit for 8,000 c. ft. The room to be smoked should be swept clean of all dirt and rubbish. The windows and ventilator covers should be closed and any chink should be pasted over by paper. If the building has no ceiling a tarpaulin should be spread over the roof but the effect of the smoke will not be quite as good because of the leakage of smoke. Only one door should be kept open for the operators. It is necessary to make the godown as air-tight as possible.

Having carried out the above preliminaries, the required number of canisters, calculated on the basis of the cubic capacity of godown should be placed at suitable places so that the smoke will be uniformly distributed. Starting from the farthest end from the open door ignite the canister by a flame produced by a couple of matches ignited together and placed immediately on the surface of the powder. After all canisters have been ignited the operator should leave the room and close the door, sealing any chinks with clay. The doors should be locked and a notice hung up 'DANGER DO NOT ENTER'. The doors and windows should be opened after 24 hours and free ventilation allowed. If the floor of the godown to be treated is made of wood the canisters should be placed on a surface of bricks or metal sheeting. It will be observed next day that all insects in the godown are dead. The godown should not be swept after smoking as to do so will remove the deposit of 'Gammexane'. (*Advisory Note No. 7, Department of Food*)

MYSORE

M. L. N. IYENGAR

MYSORE, like the rest of India, is an agricultural country. In spite of the establishment of a large number of heavy and light industries, nearly 76 per cent of the population is dependent on agriculture for its livelihood. It is, therefore, only appropriate that the first batch of post-war schemes to be sanctioned by the State Government should relate to agricultural development.

Post-war agricultural development schemes

The schemes fall under two heads (i) those concerned with production of food to make the State self-sufficient and (ii) those which deal with long-range problems of agriculture.

The authors of *Food Plan for India* (Royal Institute of International Affairs: Oxford) have defined the scope of agricultural schemes in India in these words: 'For substantial and quick results, it is essential to define a very limited number of principles and to ensure that these are given exclusive attention in the extension scheme for carrying them into effect'. The Mysore schemes adhere to the same principles through the use of improved varieties of seeds, manures and fertilizers, improvement in water supply and drainage, and control of diseases and pests.

The three principal staple food grains of Mysore are ragi, *jowar* and rice. The State is just self-sufficient, at current rates of consumption, in regard to ragi and *jowar*. In fact, in good seasons, there would be a small surplus for export. It is in regard to rice that the State is deficit to an extent of 50,000 tons per annum. The main objective of the short-term schemes is to wipe out this deficit and also augment the production of other food grains.

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Extension of area under cultivation

The area of the State is about 189 lakhs of acres. Of this about 99 lakhs are available for cultivation. More than 80 per cent of the cultivable land is occupied but only 67 per cent is cropped and about 13 per cent is left fallow. Some of it may include marginal lands, as otherwise, due to the growing pressure of population these lands would not have been left fallow. Mechanized farming appears to be the only remedy for bringing such lands under cultivation.

A beginning in this direction has been made by the launching of a Tractor Scheme for operation throughout the State. The idea is to station in each of the nine districts of the State a unit of five to six tractors for ploughing both virgin and cultivated land in the proportion of 1 : 3 to an extent of about 67,500 acres every year. There are now 21 tractors besides a fleet of six bull-dozers for jungle clearing, etc. Arrangements, it is learnt, have been made to import another 75 tractors, nearly 25 more than what was initially proposed.

Other inducements which have been in vogue since the inception of the 'grow more food' campaign for extending cultivation are also being continued. According to the latest figures, an area of 2,64,610 acres of land has been granted to cultivators at concessional terms. Of this only 1,88,138 acres have been brought under cultivation.

Extension of irrigation facilities

Although Mysore does not abound in large and perennial rivers as in the North, great efforts have been made by her people and the Government from very ancient times to harness as much water as is available in her small rivers and streams for irrigation purposes. One of the unique features in the State is the large number of tanks—nearly 2,754 major and 21,990 minor tanks studded all over the State.

There is, on an average, a tank for every 1¼ square miles of the land surface. The people are so irrigation-minded that in the words of Major Sankey, the first Chief Engineer of the State, 'it would now require some ingenuity to discover a site within this great area suitable for a new tank'.

But yet out of the 65 lakhs of acres sown to crops only about 11 lakhs have irrigation facilities due to her geographical handicaps. All the same continuous efforts are being made by her engineers to bring larger and larger areas under irrigation. About 30 projects designed to irrigate nearly 80,000 acres were pushed through during the past few years at a cost of Rs. 2·5 crores. Many of them are under various stages of execution. About nine more projects have been investigated in the Thungabhadra Valley. These are designed to irrigate 2,27,085 acres and are expected to cost Rs. 10·25 crores. In about ten years time from now, the irrigated area of the State may well stand at 15 lakhs of acres. The programmes for the next decade include restoration of major and minor tanks and construction of wells on a subsidized basis.

Intensification of agricultural production

Among the more important measures programmed for the next five years for intensifying production of food grains are (i) a scheme for the multiplication and distribution of improved paddy seeds, manures and fertilizers at concessional rates, (ii) a scheme for the manufacture of compost from town and rural wastes, (iii) a five-year plan for the wide distribution of improved implements, and (iv) organization of a plant protection service throughout the State.

Seed multiplication scheme

The area under paddy in the State is about 7·5 lakhs of acres. Although the yields in some taluks are as good as any in the world, the average yield is very poor, about 950 lb. per acre. One of the chief factors for low yields is the poor quality of the seed material that the ryot employs. Wider adoption of improved seed may go a long way in wiping out our rice deficit. Much progress has been made in this direction in recent years. Where formerly the demand for departmental seed hardly exceeded 87 tons, it stood at 1,456 tons during 1946-47. Under the scheme inaugurated recently it is proposed to bring 2·5 lakhs or nearly one-third of the paddy acreage under improved paddy by the end of the next five years.

It is also proposed to distribute through 82 depots and 124 sub-depots already established, manures and fertilizers like ammonium sulphate and superphosphate at concessional rates. The demand for these fertilizers and manures has been growing rapidly as the following Table will reveal :

TABLE I

Value of manures and fertilizers distributed departmentally

Year	Rs.
1940-41	12,994
1941-42	40,060
1942-43	1,16,755
1943-44	3,75,680
1944-45	5,78,650
1945-46	7,65,436
1946-47	14,34,233

In order to meet the increasing demand that may be made on the Government for manures and fertilizers, proposals are being considered for the extension of area under groundnuts and other oilseeds for production of cake. The Mysore Chemicals and Fertilizers Company, backed by the State Government have been completing their plans for the duplication of their ammonia plant and expect to double their present output of 5,000 tons of ammonium sulphate and 2,000 tons of superphosphate. Arrangements are also being made for the establishment of a large fertilizer factory at a cost of Rs. 2 crores in the Bhadravathi area when power from the second stage of the Jog Hydro-Electric Project is available.

A scheme for the conversion of town wastes into compost has been in operation for the last three years. Already 64 Municipalities have taken up this work. In addition to continuing this scheme, another for the conversion of rural wastes has also been launched. It is proposed to introduce these methods in about 10,000 villages (out of 19,000) within the course of the next five years.

Distribution of implements

Of the 8,73,551 ploughs in use in the State only 31,313 are made of iron and of improved design. It is proposed to distribute during the next quinquennium 1,00,000 improved ploughs or at least one iron plough for every 50 acres of cropped area. It is also proposed to distribute about 2,500 *gur*-boiling sets and mills. The total value of all improved implements proposed to be distributed during the next five years will be nearly Rs. 88 lakhs.

Arrangements have been made to satisfy the growing demand for improved implements by starting their manufacture within the State itself with iron and steel produced at the State Iron and Steel Works. An Implements Factory under the auspices of the Government was started some years ago at Hassan and it is proposed to extend the operations of this and other factories in the coming years.

Plant protection service

The Mysore Department has a well-organized Entomology and Mycology Section. The first Director of Agriculture of the State, Dr L. C. Coleman, was also the first Entomologist and Mycologist. It is, therefore, no surprise that Mysore led the way in organized control of diseases and pests. The spraying organization against Koleroga of areca and coffee, is one of the few such organizations in the country. The legislative act for control of diseases and pests was enacted in Mysore nearly 30 years ago. The State was probably the first in India to organize a parasite laboratory for multiplication and release of parasites to control sugarcane borers. But still much remains to be done in this regard. To control the diseases and pests before they assume a menacing aspect or better, to prevent their occurrence, plant protection assistants with the required field staff will be stationed in every district so that preventive measures may be organized and outbreaks checked with the greatest speed possible.

BOMBAY

R. S. DUBHASHI

DURING recent years, the activities of the Department of Agriculture increased so tremendously that it was considered essential to split up the Department for the sake of efficient control and working. Accordingly, as far back as 1945, the Department was split up into four sections—(1) Agriculture including research, education and propaganda, (2) Livestock, (3) Land Improvement, and (4) Mechanical Cultivation—all the four sections being under the control of the Agricultural Commissioner. In 1947, the sections were further reshuffled and reorganized into Directorates of (1) Extension and Rural Development, (2) Research and Education, (3) Agricultural Engineering, and (4) Animal Husbandry and Veterinary Science, all these continuing to be under the control of Agricultural Commissioner. As a result of this, the Veterinary Department which was a separate Department was merged into that of the Directorate of Animal Husbandry and Veterinary Science. Now in 1948, with the experience gained so far, the Departments have been further re-arranged into the (1) Department of Agriculture embracing research, education, extension and rural development, (2) the Department of Agricultural Engineering embracing minor irrigation, land improvement and bunding, and mechanical cultivation, and (3) the Department of Animal Husbandry and Veterinary Science including dairy development. In this final re-adjustment, the post of the Agricultural Commissioner has been abolished and each Department is under the control of a Director. It is believed that this arrangement will make it possible for the various activities to be carried out efficiently.

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Mechanical cultivation

In order to bring larger area under cultivation and to do the ploughing satisfactorily, the tractor is the one implement which can be relied upon for quality and quantity of work. The tractor service was launched in 1944. A fleet of 67 tractors ranging from 30 to 80 h.p. is at present kept for hire to the cultivators at various centres. It is intended to achieve the target of 200 tractors for service by 1952, so that 1,00,000 acres can be tractor-ploughed every year. The cultivator has already realized that the use of tractor means saving of time, money and labour. A 60 h.p. tractor can plough up 10 acres in one day of 10 hours.

During the period from October, 1946 to June, 1947, 9,000 acres in Dharwar District, 8,000 acres in Ahmednagar District, 6,000 acres in Belgaum District, 4,000 acres in Nasik District and 3,000 acres in Sholapur District were ploughed with tractors.

The tractors are hired out to the cultivators from field units, a dozen of which are operating in the districts of Ahmednagar, Belgaum, Satara, Bijapur, Nasik, Sholapur, Poona, Kaira and Dharwar. The present tractor-ploughing rates are : Rs. 22 for deep ploughing up to a depth of 15 in. ; Rs. 14 for shallow ploughing up to a depth of 9 in. and Rs. 6 for harrowing. A concessional rate of Rs. 8 is charged for shallow ploughing to the small cultivator holding not less than 20 acres of land.

Agricultural Institute at Anand

Anand in the Kaira District promises to be a bee-hive of educational institutions.

The trustees of Sheth Mansukhlal Chaganlal Trust and Sheth Maganlal Goenka Trust offered a sum of rupees 9 lakhs and 6 lakhs respectively in 1938 to the Government of Bombay with a request to establish (1) an Institute of Animal Husbandry, Dairy and Agriculture and (2) Institute of Animal Genetics and Nutrition. The Government of Bombay were pleased to accept the offer and the institutions came into existence in April, 1940 under the name of Institute of Agriculture, Anand. The objects of the Institute were (1) to impart education and training in animal husbandry and dairying, animal genetics, animal nutrition, science and practice of agriculture, rural hygiene and development of village industries, (2) to develop and maintain pedigree herds of the best milk cows and draught cattle and provide for the multiplication and distribution thereof, (3) to carry on research in animal husbandry, dairying, animal breeding and nutrition and agriculture with a view to raising the standard of rural economy with special reference to the most effective use of land, cattle production and processing of milk and milk products in Bombay Province, and (4) to popularize improved methods of agriculture and animal husbandry. The Government of Bombay acquired nearly 779 acres of land at Anand and also handed over the Northcote Cattle Farm with 2,200 acres and 500 head of cattle at Charodi and the dairy section area with 50 acres and 50 head of cattle of the Surat Farm to the Institute.

A large number of students from the genuine agricultural class is admitted to the school which is run under the auspices of the Institute. A two-year 'Krishivid' diploma course, a special short course in animal husbandry and dairying and a special short course in farm management and crop production are run at the Institute. Every year 75 to 80 students are trained in the school. The students are awarded scholarships varying from Rs. 10 to Rs. 30 p.m.

In 1946, Sheth Amritlal Hargovandas offered five lakhs of rupees for the purpose of starting a College of Agriculture at the Institute. The first year class for the degree course in Agriculture of the University of Bombay was started in May, 1947 with 110 students. This college, therefore, is the second of its kind in this province, the first being the College of Agriculture at Poona.

Across the Borders

COWS AND HENS : A PROFITABLE COMBINATION

By D. J. G. BLACK

LIVESTOCK must play in increasingly an important part in our agriculture. Although the dairy cow appears likely to remain priority No. 1, many farmers who specialized in dairying during the war are examining the possibilities of adopting an additional livestock enterprise which would augment their total output and make more economical use of available labour without the need for providing increased accommodation for cattle in winter. The question is—what sort of stock ?

Much must obviously depend on the size and type of farm, and on the labour, housing and capital available whilst the individual preference of the farmer must not be overlooked. For some years at least, the problem of an 'over supplied' market seems improbable for any livestock products, but public demand is probably keenest for more fresh eggs.

It is proposed to survey the possibilities for the development of poultry on the farm, particularly the dairy-farm ; not, however, on the usual 'pin money' or 'barnyard' basis, but rather on a scale sufficiently large to be looked upon as a commercial enterprise dovetailed into the general farming system.

This may not seem an opportune time for such a survey, as obviously present food and timber restrictions do not facilitate largescale developments in poultry. Nevertheless, whilst awaiting improvement in supplies, farmers who are contemplating taking up poultry might well commence to get together some healthy and well-bred foundation stock. This is important, for past experience shows that 'mushroom' growth of unselected poultry stocks was a frequent cause of failure. But before any new livestock enterprise on a farm can safely be adopted, several leading questions must be answered. Does it pay ? What are its future prospects ? How will it affect the farm's labour requirements, its stock-carrying capacity and generally fertility ?

Financial prospects

On this side there is the evidence of several past economic surveys showing widely varying results, such as an annual profit of over £1 per laying bird down to a loss, in some instances, of 5s. or more per hen. Such figures indicate clearly the effect of efficiency of management on results, and suggest that in some flocks there is room for improvement in management. It is fairly simple to get a rough idea of the probable gross return per hen per annum, knowing that—on the costs side—she consumes about 1 cwt. of concentrated food (less on a general farm) and —on the income side—that she produces about 12 dozen eggs a year. The difference in monetary value between these two items has to cover labour, depreciation, and other incidentals For example, at present, with food at about 18s. per cwt. and eggs at 3s. 7d. per dozen, the margin left for such items and profit per bird is 25s.

Another useful way to estimate potential profits is to compare the number of hens which it is necessary to keep to give the same profit as a cow. Wyllie[1] has shown recently that the profit per cow is in the region of £10 per annum. Taking a profit of 10s. per bird, which should readily be obtained at present, it seems that 20 laying hens will leave as much profit as a cow. Such figures are, of course, open to debate, as much depends on the breeding of the stock and the comparative managerial efficiency employed. On the farm with which the writer has been concerned for a number of years, where both laying hens and dairy cows are kept on what might be considered equally efficient lines, it has required, on the average, 23 hens to leave as much surplus per annum as one cow.

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[1] Wyllie, J. *Milk Production, Six Years Costs and Financial Results* 1939/40-1944/45, Report No. 37, Wye College.

There can be little doubt that poultry offer a more attractive capital investment than dairy cattle. Present overall capital requirements per cow are upwards of £100 : those for 25 hens are less than half that amount, and replacement costs are also considerably less.

Future prospects

Turning now to the question of future prospects, is there any risk of egg production being overdone ? Dietary experts have recommended the consumption of an egg per day per person as a reasonably attainable and desirable contribution to maintain good health. Assuming the human population of the U.K. to be 45 millions and an annual output per bird of 12 dozen eggs, it would require on that basis 114 million layers to provide sufficient home-produced eggs. Therefore, on nutritional grounds alone, there is room for tremendous expansion of egg production. But, however desirable this may be, it must be remembered that in comparison with some other countries we consumed considerably fewer eggs *per capita,* even in normal times.

In 1937, Beilby[2] showed that egg consumption in England varied according to income, the higher income groups consuming more eggs than the lower. It appears that egg consumption in the future will depend largely on the price of eggs in relation to other foods and to the purchasing power of the public. The former will be markedly affected both by labour and feeding stuffs supplies and costs, whilst the latter will depend on our standard of living in the future.

Poultry were largely consumers of imported feeding stuffs in pre-war days, and if our poultry stocks are to increase to any extent, it is apparent that heavy importation of feeding stuffs will again be necessary. The volume and price of these feeding stuffs will have considerable bearing on the future of the hen in this country. 114 million layers, it is estimated, require annually some 5¾ million tons of food and probably a further 1 to 1¼ million tons for the young stock for bi-annual replacement of layers, i.e. some 7 million tons in all—a weight exceeding out total cereal imports for direct human food.

It is generally assumed, however, that for some considerable time to come it will not be possible to import abundant feeding stuffs. Each individual farm throughout the country must, therefore, continue to be as self-sufficient as possible, so that supplies of imported foods as they become easier will be available to build up poultry stocks. Cereals must form the mainstay of poultry dietaries ; they are not essential for maintaining a high milk output. If farmers made full use of grass and grass products, larger supplies of cereals would be made available for expansion of poultry production in the United Kingdom.

Poultry manure and soil fertility

The fertilizing value of poultry manure is seldom fully appreciated. In 1939 the monetary value of poultry manure produced in this country, based on the prices of fertilizers then ruling, was estimated to be as high as £1,500,000 per annum. As the value of all imports of artificial fertilizers at the time amounted to £2,500,000 per annum and the estimated total value of all artificial fertilizer used throughout the country was £7,000,000 per annum, poultry were obviously contributing a great deal towards the maintenance of soil fertility—a point not sufficiently considered, perhaps, when the place of farm poultry in war time was decided. The question arises whether it may not be better policy at present to import more feeding stuffs for poultry for conversion into eggs and manure, than to import eggs and some types of artificial fertilizers.

It may well be argued that in pre-war days much of the poultry manure was produced on specialized poultry holdings and never found its way on to the land. This is to some extent true, and there is considerable scope for research in the methods of handling and using poultry manure. Experiments carried out at Reading, in which this manure was mixed and composted with 'Screened dust' from municipal waste dumps, indicated a way to prevent loss of the valuable plant nutrients from poultry manure, as well as improving its spreadability and destroying any weed seeds it might contain. When transport facilities improve, this method of utilizing poultry manure may be worth further investigation on a larger scale. It certainly appears a more attractive proposition than that of drying the manure and has the added advantage of utilizing other waste organic matter.

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[2] Beilby, O. J. *Egg Prices : A Study of the Factors Affecting Prices and Production.*

Although poultry, run as an integral part of the farm and worked into the farm rotation, are great restorers of fertility, only recently has their value in this respect been officially recognized. In the Fourth Schedule of the new Agricultural Act for England and Wales, which relates to improvements in respect of which consent of the landlord is not required in writing, provision is made for payment of compensation for foods consumed by poultry 'folded on the land as part of the system practised on the holding'. This recognition of the value of poultry manure is a step in the right direction; and it is hoped that the term 'folded on the land' will not be interpreted too literally, for wherever poultry are taken round the farm in portable houses—not specifically in fold units—they leave behind much fertility.

It is interesting to examine the possibilities of a cow-hen combination from the maintenance of soil fertility angle. Assuming that the poultry are fed largely on imported foods, the hen and the cow are complementary in this respect, just as eggs and milk are complementary in the human diet. It has been estimated that 100 gallons of milk remove 5 lb. nitrogen, 2 lb. phosphoric acid and 1¾ lb. potash; whilst the manure from a hen contributes 2 lb. nitrogen, 1 lb. phosphoric acid and ¾ lb. potash per annum. From this estimate it can be calculated that the nitrogen, phosphoric acid and potash removed by a cow producing 700 gallons of milk per annum would be fully replenished by the manure produced annually by 20 hens, along with ample lime supplies. In most cases it is necessary to emphasize the importance of additional lime, as the full value of poultry manure—as indeed of any nutrient replacement—is never obtained unless sufficient lime is available to prevent the development of an acid condition of the soil.

Health and stocking aspects

From the health standpoint, the old bogey of the risk of the hen affecting the cow with avian tuberculosis, and thus upsetting the T.B. test, has recently been exploded by a Ministry of Agriculture announcement[3]. Referring to the introduction of the comparative tuberculin test, which enables bovine and avian types of tuberculosis to be distinguished, it was stated: 'This development enables owners of attested and licensed T.B. tested herds to undertake poultry-keeping on an unrestricted scale'. This pronouncement certainly removes the biggest stumbling block to the partnership of hens and cows on the farm. Nevertheless the old belief that it is unwise to run fowls and cows together will die hard. Veterinary authorities contend that if the birds are kept young and managed satisfactorily, the risk of tuberculosis is negligible; and if a farmer wants to be sure of avoiding all risk, let him have his hens tuberculin tested—it is not an expensive operation.

Considering the advantages from the health aspect of running the two classes of stock, it is only necessary to watch how cattle instinctively prefer herbage behind poultry to appreciate the effects of poultry manure in improving the palatability and nutritive value of grass. In addition to the obvious preference of the cow herself, there is ample evidence from chemical analyses to show that grass after poultry is particularly rich in protein, minerals and vitamins A and C[4]. Such highly nutritious grass undoubtedly has a tonic effect on cattle of all ages.

There is also, of course, the important aspect of cattle helping indirectly to maintain the health of the poultry by keeping the grass short and well-grazed. Long, pampas-like grass is a menace to poultry, being a happy hunting ground for parasites and a frequent cause of crop binding in adults and chilling in chicks.

From the health viewpoint, there is yet another liaison between cows and chicks, which has been demonstrated recently by workers in America. It has been shown that cow manure contains a growth factor helpful to chicks. It would appear, therefore, that chickens reared on a dairy farm, with access to cow manure, may be particularly fortunate. This matter may be of more academic than practical interest in any case, the happy relationship which can exist between the hen and the cow, as regards their mutual health and well being, has already been sufficiently demonstrated.

It might be well to add that, unlike pigs and sheep, poultry do not suffer from foot-and-mouth disease; this is an important point in favour of their selection as an additional enterprise where a valuable dairy herd is already established.

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[3] Agriculture. *The Jour. of the Ministry of Agric.*, Vol. LIII, Dec. 1946, p. 418.

[4] Lowe, L. T. *Jour. of the Ministry of Agric.*, Vol. XLV, Sept. 1938, p. 580.

Stocking

What of the possibilities of the cow-hen partnership from the angle of the stock-carrying capacity of the farm? Here the hen undoubtedly scores over all other classes of stock, for she consumes relatively very little grass and thus does not compete with the cow for this cheapest of all foods.

In addition to the improvement already mentioned in quality and palatability of grass after poultry, there is also a marked increase in quantity. It is difficult to get an accurate measure of this when stock are grazing, but carefully controlled experiments carried out 10 years ago at Reading, on a light soil of rather poor fertility, on the effects of folding poultry on the yield of hay, showed a 50 per cent increase in yield. There was also some evidence of a residual effect from poultry manure which increased the following year's hay crop, but, largely owing to drought, the hay crop was very light and the results just failed to reach significance. There is, undoubtedly, need for more experimental work to demonstrate the actual improvement of productivity of grassland after poultry in terms of increased output of animal products such as milk and meat.

Besides increasing both the quantity and the quality of grass, poultry manure acts like other manures rich in available nitrogen in extending the grazing season at both ends; it is, in fact, a valuable alternative to nitrogen for the production of the 'early bite' so much popularized recently.

The old idea that grassland is far behind arable in productivity no longer holds to such a great extent where poultry are used to maintain and improve the grass. Particularly does this apply to leys, and there is no better way to restore a ley (other than ploughing up and reseeding), when, after a number of years it shows signs of declining output, than to stock it with poultry. The general experience of the writer and of those farmers who have run poultry extensively on leys has been that the growth of grass after poultry at flush seasons is such that special provision must be made for its efficient utilization or conservation. The farmer who combines cows and chickens must be skilled in grass management. He is in an excellent position to ensure not only that his cows are maintained during winter on grassland products, but also that such products enter very largely into their winter milk production rations, thus leaving more of the limited supplies of concentrates for the hens. The production cycle then becomes; feed concentrates to the hens which then produce profitable eggs, as well as manure to improve the quantity and quality of the grass: if properly utilized, the grass in its turn makes the cow less dependent on concentrates and thereby cheapens the cost of milk production.

The importance of making the best use of grassland after stocking with poultry can hardly be overstressed. Grazing is, of course, the cheapest method of utilization, but is often wasteful. Particularly is this the case where the fields are large and the grass after poultry, grows away so rapidly that it is impossible to stock it adequately with cattle. This difficulty can be mainly overcome by dividing the field by an electric fence and converting the surplus grass into silage, hay, or dried grass.

Grass drying would fit in very well where a large head of poultry are run, but the obvious difficulties for the smaller farmer are initial cost of the drying plant and high general overhead costs. In theory, a dual-purpose drying plant, which could be used in the growing season for grass drying and in winter for drying poultry manure, would be an attractive proposition. It seems, however, in the meantime, that the best method of utilizing surplus young grass, particularly for the smaller farmer, is to make silage in pits or clamps. By making silage in this way, from grass of about six weeks' growth, a first class 'watery concentrate' type of product, rich in protein, vitamins and minerals, can be obtained. On the average, two acres of grassland will yield about 8 tons of fresh grass, which, when ensiled, will give roughly 6 tons of silage—equivalent in feeding value to a ton of dairy cake. This saving of cake by making silage would release enough concentrates to keep 20 hens for a year.

Labour

In these days of high labour costs, when so much emphasis is being placed on output per man-hour, the potentialities of the cow-hen combination must be carefully examined. To ensure optimum efficiency, the poultry unit on a general farm should be sufficiently large to employ a skilled worker, or workers, full time. Such a unit—generally comprising 1,000 to 1,500 birds—can with advantage be dovetailed into almost any farming system, the only possible exceptions being mixed or dairy farms of small acreage, where less than a full 'man unit' of poultry could be carried. On many small dairy farms, for example, the present size of the dairy herd is possibly the optimum, having regard to the land available. It is very difficult—indeed almost impossible—to get an exact fit of size of herd in relation both to the acreage of land and labour; and there may be no room, as far as the land is concerned, to carry that extra cow to increase output and utilize labour to the full. In such circumstances, it may be possible to run a moderate-sized flock of poultry—say 200 birds or more—in conjunction with the dairy herd.

Thomas[5] in an economic survey of dairy farming carried out in 1931, in the Blackmore Vale, in Dorset, where the farms are mainly small—averaging 10 to 16 cows, with a high proportion of grassland—showed that the biggest profits were made on farms where a combination of cows and poultry existed. The good results were largely attributed to the fact that these smaller dairy farms needed some other enterprise in addition to cows, to ensure maximum efficiency of labour utilization.

General

Although emphasis has been placed on the possibilities of superimposing a poultry section on the dairy farm, the hen is such an adaptable creature that she can well be worked into almost any system of farming. To cite one or two examples. She links up admirably with lowland grass sheep, providing that 'early bite' of grass—described by Stapledon as 'the mother of milk'—which is so essential for successful fat lamb production. Again, large mechanized corn-growing farms will find that the hen, in addition to leaving a profit, will also maintain soil fertility—claims that can seldom now be made for folded arable sheep except pedigree flocks. There is, too, the further advantage that the hen will glean the stubbles and break down the straw after the combine, thus facilitating ploughing-in. The nitrogen in her droppings is just what is wanted to compost the straw in the soil and thus prevent adverse effects on subsequent crops due to nitrogen immobilization in the soil.

During the urgency of war, milk was produced on many small and inaccessible farms, handicapped by lack of proper building and equipment. In future such farms may find it difficult not only to have their few gallons of milk collected, but also, possibly, to produce milk up to the necessary standards of quality. In such cases, careful consideration should be given to the possibilities of replacing the cow by some other class of stock. Under these circumstances, it would be advisable to develop one type—for example poultry—on more or less specialized lines, rather than to keep small numbers of different classes of stock. An additional enterprise on the cropping side, such as market gardening or fruit farming, might be undertaken, to make full use of the manure and to provide some diversification of output.

In every case, the individual preference of the farmer will have not a little to do with the class of stock selected. It is useless to attempt to influence a farmer, who hates the sight of a hen, to take up poultry. It is the farmer who is prepared to tackle anything likely to make a profit and, at the same time, build up the fertility of his farm, who is the right man to interest. Further, he must be prepared to give his poultry a square deal, treating them as carefully as he would any other class of stock—taking every possible step in feeding and management to maintain a healthy flock. If he does so, he can be assured of success, as far as the economic position allows.—Reproduced from *Scottish Agriculture*, October, 1947.

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[5] Thomas *et alia*. *Dairy Farming in the Blackmore Vale*. Bull. No. XL. Univ. of Reading, 1931.

Home Gleanings

THE COCONUT INDUSTRY IN INDIA

THE coconut crop of the world comes out of an area of 8 million acres distributed over various countries of the East such as India, the Philippines, Ceylon and the Netherlands East Indies.

The Philippines leads both as regards area and production (2 million acres and 3,500 million nuts). India comes next in point of area (with 1·51 million acres) but ranks only third in point of production which is only 3,020 million nuts, while the Netherlands East Indies, with 1·5 million acres only, produces 180 million nuts more.

Distribution of Indian acreage

Of India's 1·51 million acres nearly two-thirds are in Kerala where it is the mainstay of the life of the people. The remaining one-third is distributed over the South Kanara, East Godavari and Tanjore districts of the Madras Presidency, the provinces of Bengal, Orissa and Bombay and the State of Mysore. It is, however, interesting to note that Madras, Mysore, Travancore and Cochin claim among themselves 95 per cent of the Indian acreage. But in no part of India does the coconut so vitally affect the lives and fortunes of the people as in Kerala where the warp of the economic fabric may be said to consist of coconut growing and allied industries such as copra-making, oil-crushing, coir-making, etc.

General backwardness

But, in spite of its great economic importance, it is a matter for regret that the entire coconut industry has been marked by a general backwardness and a slow deterioration. There have been very few conscious attempts at improvement and development, so much so, that India which, before World War I, was a net exporter of coconut and coconut products soon ceased to play that role and in 1941-42 imported as much as 181,000 tons of copra. An ever-widening gulf has been yawning between production and demand, thanks to the growing industrial demands for coconut oil, particularly from the soap industry.

The problem of problems that confronts those interested in the industry is how best to rehabilitate it and bridge the gulf between production and demand, so that the industry may be able to stand on its own legs and be freed from the nightmare of foreign competition.

Indian Central Coconut Committee

It is in this context that the Indian Central Coconut Committee was inaugurated in February 1945. The Government of India considered that the various interests of the industry could best be served by setting up an all-India organization known as the Indian Central Coconut Committee on lines for which the Indian Central Cotton Committee and similar bodies concerned with jute and lac, with their outstanding achievements afforded precedents, to watch over the interests of the coconut growers and to assist in the development of the coconut industry and the industries connected with its derivative products.

The functions of the Committee fall under four main heads, namely, (1) the conduct of research—agricultural, economic and technological—for the improvement of the commodity and the application of the results to everyday practice, (2) the improvement of the marketing of the commodity and its products, (3) the supply of information to the Government Departments, the trade and the general public on all matters relevant to the industry, and (4) tendering of advice in respect of policy on matters connected with the development and improvement of the industry.

Central and Regional Research Stations

Realizing the importance of agricultural research in any plan devised for the improvement of the industry the Committee has gone ahead with the setting up of two Central Research Stations. One is situated at Krishnapuram, near Kayamkulam in Travancore, and will investigate diseases of the coconut palm which have assumed very serious proportions over wide areas in Travancore and Cochin involving loss of several million nuts per annum. The foundation stone of this station was laid in April last by H. H. The Elayaraja of Travancore. The other Central Research Station is at Kasaragod in South Kanara District, Madras Province, and will be concerned with the fundamental aspects of coconut research.

At the same time it has been observed that improvements by agronomic means are quite local in application in view of the difference in climate and other conditions in the major producing areas. The Committee has, therefore, been convinced of the need for conducting investigations at a number of centres in the coconut growing areas. They have, therefore, decided to establish 12 Regional Research Stations distributed over the Madras Province, Orissa, Mysore, Travancore and Cochin, so that the results of the trials may immediately be passed on to the growers of the regions concerned.

These Research Stations alone would cost the Committee Rs. 12 lakhs by way of capital expenditure and Rs. 3 lakhs per annum by way of recurring expenditure. That must furnish a measure of the importance the Committee attaches to agricultural research.

Distribution of quality seedlings

The importance of the supply of quality seedlings in any planned development of the industry cannot be over-emphasized. The coconut palm is a perennial tree which comes to bearing stage only after about 8 to 10 years of ministration and lives up to an age of 80 years. Any mistake in the selection of the seedling will, therefore, prove a costly blunder. There are no reliable nurserymen who can supply quality planting material. Until recently there was only one Government nursery in South Kanara District and its output could not touch the fringe of the demand. The Committee is, therefore, financing jointly with the Provincial and State Governments concerned 8 coconut nurseries, 3 in Madras, 2 in Travancore and 1 each in Orissa, Cochin and Mysore. With a view to make available good quality seedlings to the poorest growers the price has been fixed at only four annas per seedling, although the actual cost of raising a seedling does work out at about Re. 1. The nurseries are for 5-year periods from the date of commencement and the above eight are expected to sell 3,50,000 seedlings in all.

Technological research

Improvement of the coconut industry involves also research into certain problems of technology such as the curing of copra, refinement and preservation of the oil, the utilization of the husk, the shell, etc. The production of copra in India is practically confined to the West Coast where during the non-monsoon months copra is dried in the sun while during the rains the drying is done in crude smoke chambers. The latter process has been found to be very unsatisfactory, producing as it does copra which is discoloured and rancid. It has, however, been found that copra dried in a modern hot air kiln not only retains its white colour but has only a very low moisture content. The Indian Central Coconut Committee has gone into the question of introducing the right type of hot air kiln on the West Coast and arrangements are in train to set up, at its own cost, a kiln of the Estate type popular in Ceylon in the premises of Badagara branch of the Malabar District Cooperative Produce Sale Society of Calicut as an experimental step to ascertain whether such a kiln would be suitable for conditions prevailing on the West Coast. Badagara is a brisk copra-trading centre and receives some of the heaviest rainfall on the West Coast.

The coconut oil has some problems, too. It is of the utmost importance that we get from copra the highest percentage of oil possible. There is no use leaving any oil in the cake for it is as good as wasted. Researches with regard to improving the quality of the oil will yield good results. The question of preserving the oil as it ought to be—a clear white liquid with a pleasant flavour free from rancidity—is also important. Investigations are also necessary to find out how the oil may be utilized for new food preparations and industrial purpose.

Desiccated coconut

Coconut kernel which is widely used as an ingredient in the preparation of various dishes, etc. is converted into shreds or granules and preserved in a dehydrated condition. This product is known as desiccated coconut.

In 1943 India imported as much as 1,400 tons of desiccated coconut from Ceylon. The desiccated coconut is chiefly used in the preparation of confectionery, cakes, biscuits, pastry, pudding, etc. In view of the steadily increasing consumption of the article in this country and the possibility that its demand may go up further, it should be possible to make a start in the manufacture of the stuff in India when our coconut supply position improves.

Utilization of husk, shell, etc.

The two important by-products of the coconut are its husk and shell. The green husk is generally used in the manufacture of coir by retting. The present methods of retting the husk leave much scope for improvement. By the employment of chemical and mechanical methods of retting it should be possible to extend retting to areas where backwater facilities are scarce. The huks could be utilized for extracting fibre for bristles, brushes, etc. and as stuffing material for mattresses. The economics of the various chemical and mechanical methods which have not been adequately examined, deserve to be investigated. Attention may also be devoted to see whether the coir fibre cannot be used as protective and lagging material for pipes, cables, etc. The possibilities of manufacturing compressed boards, panelling boards, tea chests, packing materials, bath mats, etc. from coconut husk and premature coconuts which the trees often shed, and which at present are not to any useful purpose, and the pith, heaps of which go to waste in coir factories, deserve serious consideration.

Technological researches regarding the use of shells for commercial, industrial and other purpose also hold out immense possibilities. On the West Coast, shells are commonly used as fuel and for firing copra-drying kilns. The coconut-shell charcoal was in great demand during the war for use in gas masks. The charcoal specially prepared and activated can be used for refining sugar and vegetable oil. During the war there was some demand for charcoal in the preparation of acetic acid for coagulating rubber in rubber factories. The possibilities of manufacturing it on a commercial scale, now that peace has been established, deserve to be explored. The shells are also used for the preparation of ladles, bowls, scoops, etc. and various other articles such as flower vases, fancy bowls, paper weights, handles and buttons and for various other useful purposes. The cottage industries connected with these deserve to be organized properly. Only a few of the more important technical problems have been enumerated above. There are many others that may call for investigation as work on the above items progresses.

Cooperative marketing

Coming to the economic aspect of the industry, the Committee attaches great importance to cooperative marketing as one of the surest means of not only bettering the lot of the coconut grower, but ensuring the quality of the copra placed in the market. At present the village copra maker has little or no power to hold on to his product and is anxious to dispose of it as quickly as possible, without caring for its quality. Cooperative marketing societies, however, help to increase members' holding power by the provision of cheap credit against stored produce, obtain better returns, encourage the members to produce quality copra and facilitate installing hot air kilns and the grading of copra. They could also arrange to purchase and distribute manure and supply members with seedlings of guaranteed quality. The two cooperative copra marketing societies at Vaikom and Narakkal have done considerable good to their members and it is hoped to start more such societies.

Grade specifications

Improvements in the marketing of coconut could also be brought about by the adoption of grade specifications for copra and oil. At present several grades and qualities of copra are recognized in the trade, but the classification is based mostly on visual examination, with the result that better types of copra do not get premium, and buyers are tempted to offer prices which may not be fair to the producers. Similarly several qualities of oil are known in the trade, but there are no well-defined grades with specifications to indicate the various quality factors or purity of the oil. Arrangements have been made to collect samples of copra and coconut oil from various parts of the country for the different seasons and analyze them with a view to drawing up grade specifications. This work has been in progress for the last six months.

Better statistics

Again there is a great necessity for improving the statistics of coconut acreage and production. The policy with regard to import, export and distribution of coconuts and coconut products presupposes accurate statistics relating to production and demand in India. Without going into details it may be stated that the available statistics about the industry are quite unsatisfactory. The question of improving these statistics has been taken up by the Committee with the provinces and States, and it is hoped that as a result of the joint action reliable statistics on the basis of which alone well-planned development of the coconut industry can take place, will be recorded on a more satisfactory basis.

Enthusing the growers

From what has already been said it will be clear how much importance the Committee attaches to development work which will ultimately help to bridge the gap between production and demand. Schemes and programmes, although excellent in themselves and put through with the best of intentions, are not apt to enlist the cooperation of the grower who is the man to be reckoned with in the last analysis. To turn the grower's inertia to enthusiasm, complacence to constructive endeavour is as much the duty of this Committee as the promotion of research, marketing and other activities. A 'grow more coconut' campaign is, therefore, being organized with a view to keeping alive in the mind of the cultivator by a variety of ways known to modern publicity the urgent need to adopt methods which will help to step up production, in the interests of his own well-being and the larger interests of the industry and the country.

Propaganda

In order to serve this end and also to furnish those interested in the coconut industry with market intelligence and other useful information a *Bulletin* in the Malayalam and English languages has begun to be published from August last.

A handbook on coconut couched in language understood by the laymen and several pamphlets are also under preparation.

By these and other methods it is hoped to wipe out the deficit in the production of coconuts, and may I add, to restore this country to the status it enjoyed before World War I as an exporter of coconuts and coconut products.—Reproduced from the *Indian Coconut Journal*, October-December 1947.

Book Reviews

THE CHEMICAL ACTIVITIES OF BACTERIA (1947)

Edited by ERNEST F. GALE (University Tutorial Press, Ltd., London, 1948, pp. 199).

THE book is a useful study to bacteriologists and biochemists engaged in higher bacteriological research and in the study of chemical life of bacteria. The author has shown clearly and in a masterly way how so minute a unicellular plant can possess enormous biochemical activities of far-reaching importance. In fact, the whole bacterial life processes are the sum total of various intricate chemical phenomena. The chapter on enzymic activity of bacteria is well-written and growth factors of bacteria have been clearly expressed. The nutritional classification of micro-organisms is a novel one and interesting. The chapter on pathogenicity and chemotherapy is fascinating. The author has expressed in lucid ways the difference between a pathogen and a saprophyte on the chemical basis. The book, although concise, is a mine of information. The diagram depicting the size of bacteria and viruses is appealing. It would have been well if the author had tried to follow the diagram and to give some idea about the chemical activities of viruses as well. (G.P.)

FERTILIZER SHORTAGE IN INDIA

ONE of the more important causes of the slow progress of food production in many parts of the country and the failure to expand it in others has been an extreme shortage of fertilizers, particularly nitrogen.

Indian soils are particularly deficient in nitrogen and for the bulk of her requirements of nitrogenous fertilizers, India has to depend upon imports. It is estimated that India's total requirements of nitrogen for all crops is 2m tons per annum as against an allocation of 40,000 tons for 1948. At present there are only 5 net exporters of nitrogen—Chile, Canada, U.K., Norway and Belgium. It is the exporters of these five countries that have to supply the needs or supplement the domestic production of nearly 100 importing countries. That explains briefly the reason why India has been able to secure only a small fraction of her chemical fertilizers from abroad. (*Food Bulletin*, April 19, 1948.)

News and Views

I.C.A.R. CONVOCATION

THE first Annual Convocation for the award of certificates to the students who successfully completed the Statistical Training Courses organized by the Indian Council of Agricultural Research was held on 29 March 1948 under the presidentship of Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture. Welcoming the Hon'ble Minister, Sir Datar Singh, Vice-Chairman of the Indian Council of Agricultural Research reviewed the origin and growth of the Training Course in Statistics. Giving an account of the largescale sample surveys for estimating crop yields at present in progress in India, he said that almost all the provinces were trying out a uniform method of random sampling under the direction of the Statistical Adviser of the Council. The work done had won recognition of experts in the leading countries of the world and in the opinion of an outstanding world authority on the subject the researches carried out by the Council 'rate about the highest in the world'. He was glad to be able to announce that Dr. Sukhatme, the Statistical Adviser, had been elected Vice-President of the Standing Advisory Committee on Statistics set up by the United Nations Food and Agricultural Organization. He added that the Council was trying to set as high a standard as possible for the training of professional statisticians.

Congratulating all those youngmen who had been able to secure certificates and prizes, the Hon'ble Minister said that they should regard themselves as devoted servants of the people. 'It is impossible', he said, 'to build our broken India unless those who are in various branches and sections of Government Departments feel one with the people'. He added that there was plenty of work to be done in this country. We should only shed our inferiority complex and measure things correctly. 'Let us feel proud', he continued, 'when we look upon the past, but let us not be content with our present bank-balance. Those few who have learnt statistics must add to their knowledge and continue to add to the knowledge of the world. I do hope that you will measure things in their true proportion. You may be scientists or you may be Government servants, but never forget that the country is looking to you for service and help'.

The Hon'ble Minister was pleased to award certificates to the folowing successful candidates:

Certificate Course Examination

1946

1. J. N. Kapoor
2. P. N. Saxena
3. T. P. Abraham
4. Piara Singh Sahota
5. N. S. Chowdhary
6. D. Ramayya

1947

7. V. N. Murty
8. Miss Vilas Agarwal
9. H. C. Saxena
10. S. D. Chirsti
11. D. P. Pande
12. N. B. Advani

Short Course Examination

1946 and 1947

1. S. P. Misra
2. R. K. Aggarwal
3. Ram Sarup
4. A. K. Bhatti
5. G. G. Mariwala
6. Mir Aslam Khan

A gold medal named after Mr. M. S. Randhawa, formerly Secretary, Indian Council of Agricultural Research, now Deputy Commissioner, Delhi, was awarded to each of the successful candidates standing first in order of merit in the Certificate Course Examinations. Mr. J. N. Kapur stood first in 1946 and V. N. Murty in 1947. (B.K.M.)

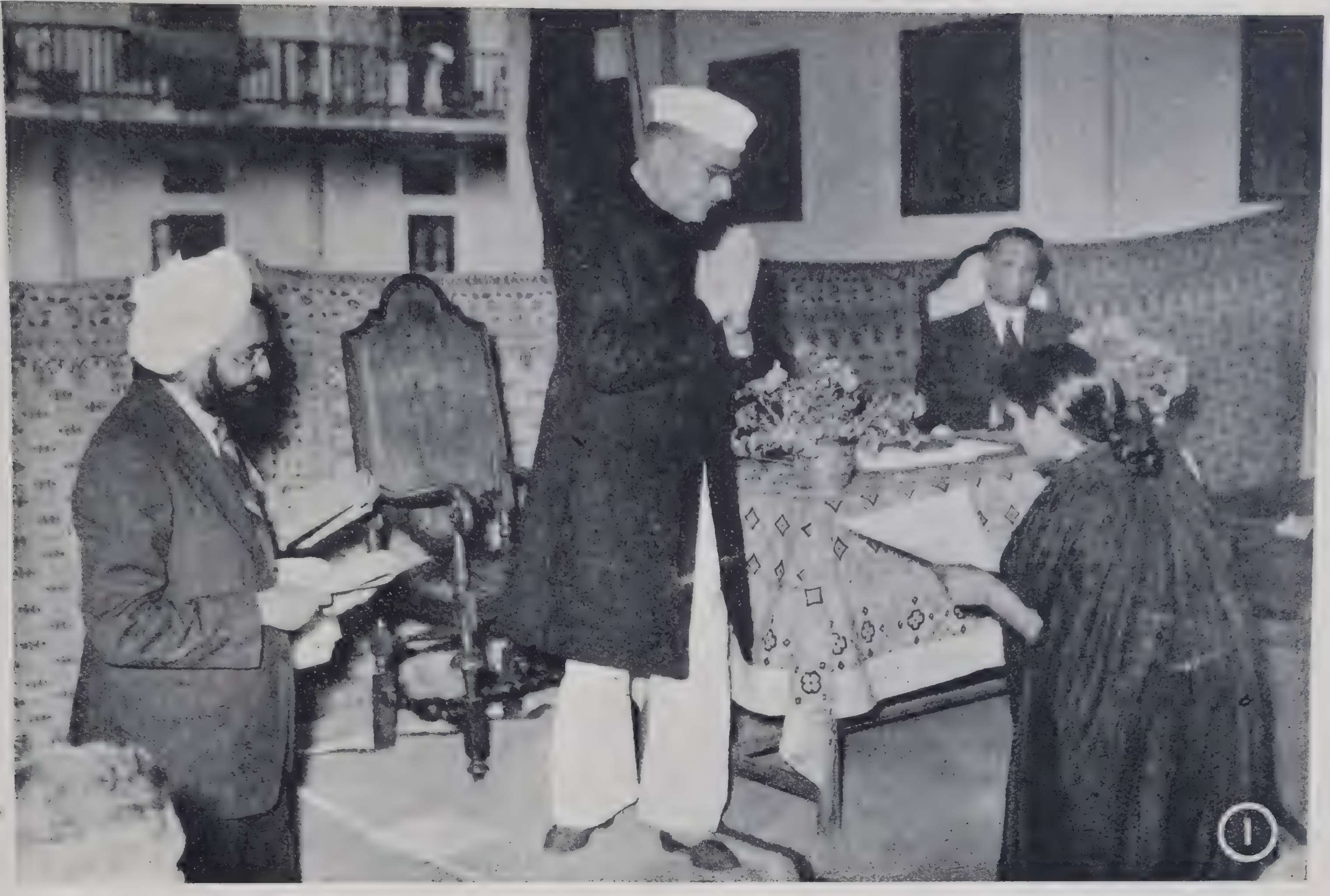
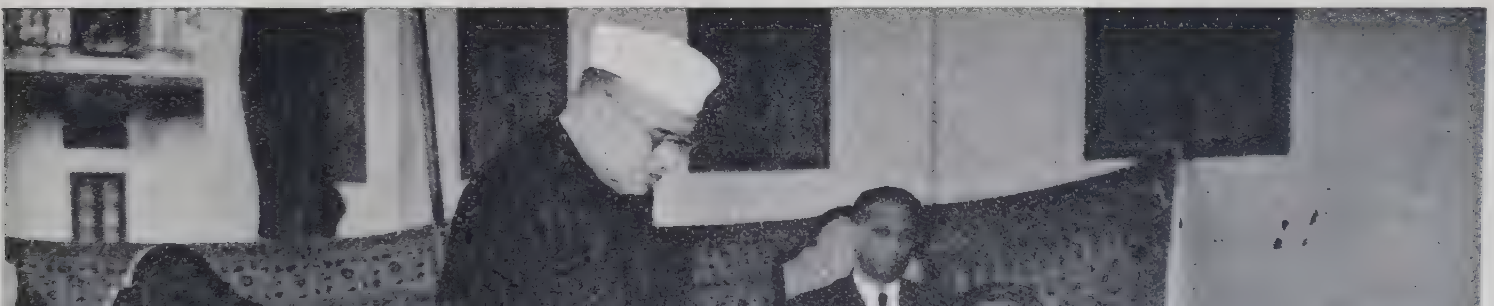


FIG. 1. (above)
FIG. 2. (below)

The Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, awarding certificates and prizes to successful candidates at the Annual Convocation of the Indian Council of Agricultural Research held on 29 March 1948.



PAPAYA: THE TREE OF WEALTH

By JOSEPH KALMER

ANYONE who has lived in the tropics will have eaten papaya at one time or another, but few of them know that the rubber-like juice which sticks to their hands from it is called 'papain', and is used in various industries and even in medicines. For instance, papain is used for de-gumming natural silk when it is mixed with rayon or wool in fabric weaving. It is used in making certain cosmetics; it can be used for tanning leather, tenderizing tough meat, and for other purposes.

Dried latex from the skin of papaya fruit is so popular with producers in the United States, that the production of papain was increased ten-fold during World War II. In 1939 it amounted to 10,480 lb., valued at about £3,500 (Rs. 46,585); in 1945 it amounted to 109,760 lb., valued at nearly £50,000 (Rs. 6,65,510).

Ten years ago, people in Tanganyika knew little of the real value of papain. In 1935, at Arusha, a missionary tried to cultivate it on the fertile volcanic soil of Mount Meru, and was given every possible assistance by the agricultural officers. Today nearly every planter in Arusha grows papayas; they bear fruit before they are a year old, and produce 60 to 100 lb. of pure papain per acre.

But there is a certain amount of risk in planting papayas, for only the female trees bear fruit, and the trees (they are really shrubs) can only be sexed when they first blossom. Male papayas are then cut down ruthlessly and new plants put in their places in the hope that some, at least, will produce female trees.

If worms do not get at the seeds and the planter waits long enough, he can be sure of having every inch of his plantation covered some day with female papayas. Only a very small number of male papayas are left to fertilize the female trees with their pollen. But there is one thing the planter must do: he must keep the ground round about the papayas free from weeds. Latterly, small tractors have been used for this purpose.

It takes seven to eight months before the papaya tree bears fruit and the latter can be tapped to obtain the latex. Tapping can then take place every 10 days throughout nine months of the year. The papaya bears fruit and can be exploited for three to four years. Tapping is done by cutting very delicately with a razor blade. The latex coagulates very quickly, whereupon the lumps are collected and further dried in sheds. They are freed from all dirt such as leaves, dust and pieces of skin, by placing them on trays. Since papaya juice has a strong corrosive effect, collectors have to handle it very carefully.

The drying sheds contain ovens from which long pipes lead hot air along the lumps of latex laid out on trays for drying. The temperature should be about 100°C., and drying takes about 12 hours. After drying, the papain is packed in cans and sealed. It has now reached the state in which it can be despatched to the United States and earn the dollars which are now sought so eagerly everywhere. (*B.I.S.*)

I.D.R.I. DIPLOMA

THE following are the names of successful candidates in the Indian Dairy Diploma Examination held at the Indian Dairy Research Institute, Bangalore from 27 October to 7 November 1947.

1. Wilfred Abeywarna
2. S. Kulbhushan
3. Kashmirlal Arora
4. Abdul Azeez
5. S. Mohamed Mustaque
6. Mohamed Abdul Ghani Khan
7. Ahobala Sastry
8. Kanwar Sitaram Haldiya
9. T. S. Aiyaswamy
10. Balakrishna Mathur
11. P. Nanjappa
12. Sachindranath Das
13. K. R. Sheriff
14. Ambika Prasad Bhatt
15. Mohamed Habib Ali Khan
16. M. V. Gundu Rao
17. Ambalal Singhvi
18. Zenalabuddin Khazi
19. Abdul Saboor Chowdhuri
20. H. C. Basvalingiah
21. Megh Raj Sharma
22. Kartar Singh
23. P. Choba Singh
24. Sudhi Chandra Nayak

COVER ILLUSTRATION

Cattle and sheep migration.

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 5
MAY 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.5.48
2,800

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The Indian Council of Agricultural Research does not accept responsibility for opinions or statements contained in contributed articles or in advertisements in this magazine.

Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London WC 2.

Opening ceremony of the Seventh All-India Cattle Show at Bela grounds in Delhi on 20 February 1948 by Hon'ble Shri Jairamdas Daulatram, Agriculture and Food Minister of the Government of India.

RADIOS
CHANDRA RADIOS.

Hon'ble Shri Jairamdas Daulatram delivering his speech at the Seventh All-India Cattle Show.

PLATE 13

INDIAN FARMING

MAY, 1948

Vol. IX No. 5

IMPROVING INDIA'S CATTLE*

I AM glad it has been possible for me to snatch some time from other urgent duties and come and open this All-India Cattle Show. I have come because I realize the important place which the cattle problem occupies in the national economy of our country. With so many big questions confronting the nation at the present moment, it may appear as if one were diverting time to a small affair in performing the opening ceremony of this cattle show. Clouds are still thick over Kashmir, scarcity and who knows worse is in the offing in Madras, our fellow Indian evacuees from Pakistan are still awaiting full response from the people of India. Other problems also occupy our present thoughts. But despite these urgent calls on our time and attention, we cannot afford to ignore those problems the far-sighted solution of which affects the very foundation of the nation's economic life and, therefore, the happiness and well-being of our people. Our country has achieved its freedom. Let us fill in now the true contents of such freedom. Let us reconstruct the nation's economic life on right lines. And so in the midst of other demands on us, we cannot but spare time and energy to concern ourselves with programmes which are intended to give a proper direction to long-range plans for our country's economic welfare. Hence it is that you find me in your midst even though it be for a brief while. I have agreed to participate in to-day's function not because I am Minister of Agriculture but because I fully appreciate the importance of cattle wealth to our predominantly agricultural nation and, therefore, its close connection with the vital interests of the people.

Cattle Show Society

I congratulate the workers of the All-India Cattle Show Society for the good work it has been performing. The Society was started by the Government of India in the year 1938 with the object of organizing and establishing periodical shows of cattle and poultry and to carry out all activities for the furtherance of breeding and improvement of livestock in India, to undertake propaganda for the improvement of animals and poultry in India and to spread the knowledge of the principles upon which better animals and poultry may be bred. Besides the central show held in Delhi, two regional shows and several smaller shows in the well-known breeding tracts are held annually with the help of provincial and State Governments. I know the Society can do far more service if its financial resources were greater and I hope it will not be long before its funds are substantially augmented to help it to serve better the cause of agriculture.

Two-fold problem

You know that India is essentially an agricultural country and cattle are the backbone of agriculture. About 80 per cent of India's rural population is agriculturist, for whom cattle have an importance of their own. They occupy a unique position in the rural economy of this country and have therefore been an object of special care and affection in India from the most ancient times. Our problems are two-fold. We need more milk and milk products to provide an adequate diet to our people and we need better, healthier and stronger bullocks, for in all agricultural operations oxen are indispensable to the Indian farmer.

---

*Speech delivered by the Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, while performing the opening ceremony of the Seventh All-India Cattle Show in Delhi.

Present position

We possess one-third of the total cattle population of the world. According to the 1941 census report, the total bovine population (cattle and buffaloes) of undivided India was 208·2 millions. It is estimated that as a result of the partitioning of the country, about 30 million cattle have gone to Pakistan. In spite of our huge cattle population, the country is in short supply both with regard to bullocks as well as milk. One of the main reasons is that our cattle suffer essentially from food shortage. The slow process of starvation to which our livestock is exposed, is evident from its unthrifty condition, poor productive capacity, stunted growth, late maturity and long intercalving period. We thus lose millions of tons of milk and an enormous amount of horse power. Do we realize what this means in terms of national health and production and therefore of national wealth? As matters stand at present, not more than 60 per cent of the fodder required is available and only one-fourth of the total concentrates needed can be obtained. The position with regard to the supply of milk is still worse. About 22 million tons of milk is produced annually from cows and buffaloes in India. This must be increased to about 65 million tons to meet the minimum nutritional requirements of our people when calculated at the rate of 1 lb. of milk per day per head of the population (8 oz. in milk and 8 oz. in the form of milk products, *ghee*, butter, etc.). To allow for the feeding of calves, another 10 million tons is needed. The present *per capita* consumption of milk in this country is only 5 to 6 oz. In some of the other countries, it is far greater. It is as much as 40 oz. in Denmark, 45 oz. in Australia, 35 in the United States and 39 in Great Britain. It would thus be seen that although we possess the largest cattle population in the world, we supply the least quantity of milk per head for human consumption. Cattle rearing in this country is carried out under a variety of adverse climatic and other environmental conditions. The average cattle breeder is poor. He lives on small fragmented holdings, the majority of which are less than five acres. The average size of his herd consists of only two to three animals as against 27 to 28 in countries like England and the United States. The units are thus uneconomical and the individual owner cannot by himself introduce any appreciable improvements.

Considering the immensity of the task and the numerous complications, the solution is not easy to find, but it is evident that we must endeavour to improve our cattle by better feeding, breeding and management.

Better feeding

The problem of providing more fodder and concentrates for our cattle is indeed difficult, for pressure on land is already heavy and there is serious competition between man and animal. In any plan to bridge the gulf between supply and demand as regards deficiency in cattle feed, the requirements of human beings must, of course, receive primary consideration; but on a careful review of the entire position in regard to cultivation and yield as a result of introduction of the latest scientific methods, it appears possible that by re-adjustment of our cropping programme some extra feed can be made available for cattle. But their total requirements can only be met if production from land can be increased by about 50 per cent. We must, therefore, tap every other source to supplement food for cattle. These sources can be:

(1) Hay and silage making out of the surplus grass which is available during monsoons should be practised all over the country. There are 136 million acres of grazing land in India. No precise data are available as to how much grass this land produces, but the limited information we have, goes to show that the production of grass is about 2 tons green per acre. At least one-third of it could easily be preserved as hay or silage. All this now goes waste.

(2) Many forest areas under the Forest Department grow large quantities of grass which should be made use of by cutting and preserving as hay or silage.

(3) Crops which are known not only to increase the quality of nutritious fodder but also improve fertility of the soil such as berseem should be extensively grown, wherever possible.

(4) Large quantities of oilcakes are at present used entirely for manurial purposes. It is a matter for consideration if this cake would not equally serve the object in view if some of it is passed through cattle.

(5) The Nutritional Laboratories of the Indian Veterinary Research Institute have extensively explored the possibility of new sources of foodstuffs and it has been shown that

mango seed kernel, munj, kans, *jammun* seed, acacia pods, groundnut husk, *bawar* seed are rich in feeding value and can be extensively used as feed for cattle.

(6) The deficiencies in rice straw, if corrected by the addition of bone ash, will increase the utilization of this foodstuff.

(7) A great deal can be accomplished, if the mixed farming practices are more widely adopted.

(8) Thirty per cent of waste can be saved if all the fodder is chaffed before being fed to cattle.

(9) More use should be made of fodder bearing trees, as their leaves and pods provide excellent fodder.

(10) The fish meal industry in the country should be developed so that more of highly concentrated protein food is made available in the form of fish meal for cattle.

Improvement by breeding

Planned scientific breeding of animals is also necessary for improvement of our cattle. A number of Government farms are at present producing pedigree bulls of various breeds and these animals are distributed in the villages for the improvement of local stock. There are about 45 such farms in India which annually issue about 1,868 bulls. Considering the requirements of the whole country, these 1,868 bulls distributed annually do not meet even 1 per cent of our annual requirements. To produce the bulls required annually for the whole country at the Government farms is not a practical proposition. Our efforts to improve the village cattle should, therefore, be concentrated in the following directions :

(a) All bulls issued from farms should be located in a specially selected breeding tract and concentrated in a few villages, so that casualties and replacements are assured. From this area all other male stock should be removed. In due course, these 'key villages' would be in a position to supply the better bred animals for distribution in other areas.

(b) Efforts should be made to evolve dual purpose breeds, that is, breeds which would produce good working bullocks and also yield a fair amount of milk. Work in this connection is in progress with some of the indigenous breeds such as the Harianas and the Hallikar. The Government of India are now setting up a farm at Jubbulpore, where it is proposed to study this problem in great detail.

(c) The method of artificial insemination is being widely practised in several other countries, where it has definitely proved its value. Work done at the Indian Veterinary Research Institute has shown that a great deal can be achieved even under Indian conditions. Four experimental field centres set up recently have yielded very promising results. By the adoption of this method one bull can do the work of 10 and extensive use can be made of really superior sires. It is, therefore, essential that necessary steps should be taken by all provinces and States to explore the possibilities of the use of this method to the fullest extent.

I do not propose to deal in to-day's speech with all the problems relating to our cattle wealth and thus blur the main outline of the picture. I want on the contrary to draw particular attention to that outline alone. Hence I propose to content myself with the brief reference to the outstanding features of the cattle problem in our country. The topical questions of the prevention of slaughter of cattle or the salvage of useful cattle from slaughter, and the insurance of cattle are all under examination by Committees and I hope their results will be before the public before long. These and other allied questions will be, I trust, satisfactorily dealt with in due time. This will however be only possible if we realize that the cattle problem in India is not merely a humanitarian problem of animal welfare but that in it are substantially involved both the health and wealth of our nation. The earlier we realized this the sooner shall we see the end of poverty and disease in this country.

We have met under the shadow of a great national tragedy. Within a yard from here lies a simple memorial of the life and work of the greatest well-wisher of the animal world. Let us follow his lead in solving the cattle problem of our country and so do our duty even in a small way in keeping alive our departed leader's memory in this land.

Original Articles

SOME PUBLIC HEALTH ASPECTS OF MILK INDUSTRY IN INDIA

II. MEASURES FOR SAFEGUARDING THE WHOLESOME VALUE OF MILK

By K. C. SEN and H. LAXMINARAYANA

WHILE an adequate supply of milk to the population is a matter of vital national importance, a primary requisite in this direction and of greater importance from the public health point of view is the production of milk that is clean, safe for human consumption and that possesses other desirable attributes necessary for maintaining its nutritive and economic value. A consideration of the conditions which determine the quality of milk as a wholesome article of food, particularly its highly perishable nature and its continual susceptibility to microbial attack during its production and handling, will reveal that the proposition is not easy to accomplish.

Till about the end of the 19th century, there was no organized milk industry in any of the Western countries. Sanitation in milk production was unknown. The quality of milk supply varied greatly; its food value was very uncertain and sometimes seriously lowered due to wilful adulteration and skimming. Losses of milk by souring were very frequent and it was difficult for anyone to secure milk of any assured quality in the market. The addition of all sorts of preservatives to milk to increase its keeping quality was a common practice. From this backward condition, the milk industry has developed into the present state of efficiency in the course of just three or four decades. The early methods of milk production and marketing in the West have been thoroughly revolutionized, crystallizing in the development of a vast dairy industry, which has brought to its aid every possible safeguard known to sanitary science. It would be interesting to examine how this remarkable improvement has been brought about and by what methods the wholesome value of market milk has come to be protected.

K. C. SEN, D.SC., is Director, and H. LAXMINARAYANA is Assistant Dairy Bacteriologist, Indian Dairy Research Institute, Bangalore.

Development of market milk

The first important development towards the rapid improvement of milk industry in the West was the early evolution of organized and collective methods of milk production and marketing, which facilitated the application of scientific knowledge in regulating the trade. Evolution of organized milk production in the West has more or less followed the development of modern civilization and the advances made in various branches of the biological, engineering and social sciences. In the earliest ages, each family generally maintained some domestic cows to meet its requirements of milk. In some cases, milk was obtained from neighbours, who had surplus milk to sell and who eventually formed themselves into a class of professional milk producers. As the milk was consumed or utilized within a short period of its production and not unduly exposed to infection in the interval, the question of its safety or spoilage due to any causes did not have much significance. The highly perishable nature of milk was, however, known and milk was generally boiled before storing it, while all surplus milk was converted into products like butter, cheese, and fermented milk with a view to conserving its valuable food constituents for use over extended periods. The manufacture of condensed milk and milk powder was a later development.

With the growth of modern cities and increase of urban population, the conditions were radically altered, leading to the gradual elimination of the system of family cow-keeping and the establishment of dairy farms in areas outside the city where land was cheaper and milk production was more economical. This factor, combined with economic reasons and the regulations enacted for governing the conditions of milk production, resulted in pushing the producing areas farther and farther away from the consuming centres, necessitating the transportation of milk over long distances with all its attendant difficulties. The farmer either delivered his milk in cans direct to nearby towns or to the nearest railway station from where it had to be transferred to the city and distributed to the customers in open vessels. The increased production of milk on a commercial basis and handling of bulk milk soon led to the formation of country milk receiving stations for the collection of milk from individual farms, their prompt cooling and transportation to the towns and city milk plants where the milk was processed and distributed to the consumers. The collecting depots were either owned by city wholesalers or retail dairy companies or special distributing firms or they were run on cooperative lines by associations of milk producers. The introduction of cream separators in 1878 led to the establishment of creameries and factories for the utilization of surplus milk either independently or in conjunction with milk receiving stations and city milk plants. In this manner, commercialized methods of milk production and marketing gradually came into existence by the end of the 19th century and they brought in their trail a number of technical and economic problems for solution.

The most important problems encountered during these early developments were, (1) the premature spoilage of milk resulting in heavy losses, (ii) the difficulty of transporting milk in a good condition over long distances, (iii) safeguarding the interests of the consumers against the supply of unclean and unsafe products and (iv) protection of the genuine trader against unfair competition. With the gradual realization of the significant role played by micro-organisms in the deterioration of milk and in the transmission of several diseases to mankind, followed by the development of scientific methods of reducing the bacterial infection in milk and regulating the conditions of its production and marketing, the above difficulties were overcome.

Methods of reducing bacterial infection in milk

Development of scientific knowledge: The pioneering investigations of Pasteur, Koch and Lister in the latter part of the 19th century were responsible for throwing some light on the role of micro-organisms in the deterioration of milk and milk products. The importance of milk as a carrier of diseases appears to have been known in Italy and other countries in Europe as early as the 16th century and possibly much earlier in India and other Eastern countries, but Koch, Bang, Pasteur and a host of other scientists provided experimental proof regarding the relation of bacteria to disease and the transmission of diseases to man through the consumption of infected milk. This knowledge, combined with the epoch-making discovery of Koch regarding the cultivation of bacteria under artificial conditions, stimulated rapid advances in the bacteriological and medical sciences. The development of tuberculin, blood agglutination and cultural tests enabled the early adoption of methods for the diagnosis and control of cattle diseases like bovine tuberculosis, contagious abortion and mastitis, thereby greatly ensuring the purity of milk. At the same time, the unique importance of milk in human nutrition and the dangerous consequences following either an insufficient supply of milk in the diet or the consumption of milk with lowered nutritive value due to abnormal composition, adulteration, and bacterial action, were demonstrated by nutritional and medical workers. All this knowledge had the effect of stimulating interest in the production of a clean and safe milk associated with normal chemical composition and good keeping quality. The subsequent researches were centred round the development and evaluation of suitable measures for achieving the above objective, while safeguarding the interests of the industry.

Sanitary milk production: The first step in this direction consisted in realizing the importance of sanitary methods, use of sterile containers, cooling of milk and its storage at low temperatures, and various other precautions against contamination during the handling of milk. As a necessary corollary to this, suitable methods of processing milk, calculated to improve its keeping quality and ensure its safety for consumption, methods of cleaning and sterilization of dairy utensils, and laboratory tests for assessing the bacteriological quality of milk, were developed in course of time.

Numerous campaigns were then started in the United States, England and other countries to carry on educative propaganda regarding the importance of sanitary milk production and supply of pure and safe milk to the people, particularly children. Two of the most notable steps taken in the United States towards improving the quality of milk were (1) 'Certified Milk' movement inaugurated in 1893 for the production of high grade milk under strict medical and sanitary supervision and (ii) the nation-wide movement started by the American Child Health Association in 1923 for ensuring a safe and clean milk supply to the population. The question of dairy sanitation and the methods of supplying the consumer with adequate and safe milk supplies also engaged the early attention of the United States Department of Agriculture, and the various State Agricultural Colleges and Experimental Stations, who helped in carrying out researches and extension programmes for quality improvement. By 1929, under the cooperative extension scheme, 78,552 farms had improved their practices relating to production and care of milk in order to make their product more sanitary. State and city health officials also adopted regulations to protect it against all manner of contamination. Dairymen were required to keep their stables and cows clean, to build milk houses with proper facilities for cooling and thoroughly to cleanse and sterilize milk pails and cans. Frequent physical examination of dairy cows by competent veterinarians were made obligatory and livestock sanitary officials urged cattle owners to eliminate infected animals from their herds. As soon as it was realized that purity and cleanliness of milk were the chief requisites for flavour and general wholesomeness and that the real interests of both the milk producers and the public health control officials ran parallel, dairy organizations began to evince interest in improving the quality of milk. They arranged for the routine inspection of dairy farms, instructions to dairymen in methods of producing better quality milk and laboratory tests to determine the quality of milk delivered by individual farmers. The system of paying premiums for high quality and making deductions for lower quality milk was also introduced and this price-incentive added to the advantages already secured from better markets for better products. Scientific and industrial research institutions on their part cooperated in providing information regarding efficient methods of laboratory control, sterilization of utensils and other related subjects, as well as in giving training to persons in scientific methods of animal management and dairying. As a result of all these steps, very rapid advances were made in the United States in the sanitation of milk production and handling. The milk producers were able to eliminate largely the visible dirt and reduce bacterial content in milk. For example in Ithaca, N.Y., the average bacterial content of market milk was reduced from 760,250 per ml. in 1907 to 142,860 per ml. in 1914. In 1907 only 10·59 per cent of the samples showed a bacterial content of less than 10,000 per ml., whereas in 1918 the figure increased to 48 per cent. The number of cattle tested for tuberculosis rose from 134,143 in 1918 to 90,330,804 in 1931.

A similar improvement in the cleanliness of milk supply was effected in England. Increased attention was paid to the hygiene of milk production partly as the result of early legislation, partly as the result of schemes for the payment of bonus for high quality milk. The clean milk competitions held by the Ministry of Agriculture and the educational propaganda as well as advisory services organized by the National Dairy Council, Milk Marketing Board, the National Institute for Research in Dairying, Reading, and a number of other institutions tended to increase the interest of the producer in the quality of the article he was supplying and hasten the improvement of the quality of market milk.

Processing of milk : Development of pasteurization

The introduction of pasteurization was one of the most important milestones in the rapid development of modern dairy industry. Although the use of sanitary methods helped in obtaining clean milk having a low bacterial content and guaranteed to possess long keeping quality, two difficulties still existed. One was the problem of transporting large volumes of milk over long distances and delivering it to the consumers in a good condition. The other was the supply of milk that could confidently be declared safe for consumption, because any amount of care bestowed whatsoever in the handling of milk could not ensure its complete freedom from pathogenic organisms.

As soon as it was known that micro-organisms were responsible for the spoilage of milk and that milk could act as a vehicle for communicating serious diseases to man, various methods were employed for effecting the destruction of bacteria in milk namely, addition of chemical preservatives, refrigeration and freezing, application of electricity, X-rays and ultra-violet radiations, heat-treatment, condensing, drying and fermentation. A number of chemicals, e.g. boric acid, formalin, hydrogen-peroxide, salicylic acid and benzoic acid, were used for the preservation of milk mostly by unscrupulous milkmen anxious to mask the results of their careless methods. With the realization of their injurious effects on human health, the use of preservatives was gradually discouraged and in many countries altogether prohibited by official regulations. Refrigeration was a very useful means of retarding bacterial action and preserving milk and up till now it has proved to be the best method for long distance transport. The freezing of milk for purposes of transportation and storage was not useful on account of the physical effect which made the remelted product unattractive. It was, however, proved that many bacteria, including pathogenic organisms, were able to survive cold storage or freezing and in cases of milk carrying high bacterial content, the deterioration of milk proceeded even at low temperatures. The exposure of milk to electric current and light radiation did not prove quite effective in destroying bacterial life or practicable under conditions of commercial milk handling. This has, however, drawn some interest in recent years and irradiation of milk is becoming popular mainly on account of its effect in increasing the vitamin D content of milk. Condensing, drying and fermentation were mainly employed for the preservation of the food value of milk in the form of milk products, since the reduction of moisture content caused in the first two cases and the products of fermentation formed in the third case did not favour bacterial growth. These principles could, however, be usefully employed in the manufacture of milk products and not in protecting liquid milk for the market. Among the different methods, heat treatment of milk ultimately proved to be the only practicable and efficacious means of destroying micro-organisms and of rendering milk safe because almost all the organisms, the disease-producing bacteria in particular, were found to be markedly susceptible to high temperatures.

It was known from time immemorial that boiling was the most effective way of preventing its early souring. After the relation of milk to public health became known, the application of this process for market milk became popular in some countries of Europe. Towards the end of the 19th century, Dr Soxhlet of Germany devised a small home apparatus for heating milk in bottles at boiling temperatures for 40 minutes with a view to supplying safe milk to infants. Following this, many commercial organizations started supplying heated milk. Jacobi in New York City advised that milk for infants be boiled in the feeding bottle and recommended the adoption of Soxhlet's method for the purpose. He seems to have been the first health expert in the United States to advocate heating of milk, and the first depot to distribute heated milk was started in New York in 1889. The production and supply of sterilized milk (heating milk in bottles at 212°F. for 30 minutes) then enjoyed popularity for some time. These methods were not, however, found successful in the largescale handling of milk for the market on account of their drastic effects on the physical and nutritional properties of milk. Sterilized milk in bottles is now sold only in some isolated places here and there and boiling is confined to householders who purchase raw milk.

Pasteur was the first to demonstrate that relatively low temperatures (122°F. to 140°F.) were sufficient to destroy obnoxious oganisms in wine without destroying the other properties. This formed the basis of the principle of pasteurization. He also showed that milk could be kept sweet for a longer time if heated in this way. The industry was quick to realize the importance of this method as an effective means of improving the keeping quality of milk without altering its flavour or other properties. Its significance as a safety measure in milk supply was realized by the medical and public health profession only later. A continuous heater for milk developed in Denmark in 1890 was largely used as a commercial rather than as a public health measure. In 1892, Nathan Straus, a public philanthropist, started a number of milk stations in New York City where milk heated to 167°F. for 20 minutes was dispensed.

From this time, development of suitable methods of pasteurizing milk progressed rapidly. Till about 1905 the 'Flash' pasteurization, based on the continuous flow method of heating milk at temperatures ranging from 158°F. to 165°F. with indefinite holding times and inaccurate controls, was used in the United States. In Europe, the momentary heating of milk up to temperatures between 145°F. and 165°F. was followed. The 'Flash' system however proved valueless as a means of reducing the risk of milk-borne infections. As a result of many laboratory experiments conducted during this period, it was found that all milk-borne pathogens were killed by heating at 143°F. for 30 minutes and at 160°F. for 15 seconds. According to Dr Rosenau of the United States Public Health and Marine Hospital Service, heating milk at 140°F. for 20 minutes was just sufficient for the destruction of the most heat-resistant milk-borne pathogen, the tubercle bacillus. These findings inspired confidence in the employment of low temperatures for pasteurization and formed the foundation for the development of the Holding Method (first devised by H. L. Russell of Wisconsin in 1895) and for the subsequent general acceptance of the process by health authorities. Two methods of pasteurization, viz. (i) the Holding Process, where milk is heated to 140° to 150°F. for 30 to 45 minutes, and (ii) the High Temperature Short Time Process (a modification of the original Flash Method), where milk is heated to 160° to 162°F. for 12 to 20 seconds by the continuous flow system, emerged. The first apparatus for pasteurizing milk by the Holding Method on a commercial scale in the United States was installed in New York City in 1907 and was soon accepted widely. The Holding Method (heating to 145° to 150° F. for 30 minutes followed by cooling to 50°F.) was officially adopted in England in 1923. The H.T.S.T. Process became more popular in the United States where the public health authorities recognized both methods (heating every particle of milk to at least 143°F. for at least 30 minutes or to 160°F. for at least 15 seconds in approved and properly operated equipment). Recently this method has also been recognized in the United Kingdom. A variant of the H.T.S.T. Process known as 'Stassanization', developed by Dr Stassano in France, as well as other modifications of both the methods have been in use in the Continent of Europe.

In the initial stages, pasteurization was not taken up wholeheartedly due to the controversies raging about the supposed lowering of the nutritive quality of milk caused by it. It was also feared that its introduction would ultimately result in lessening the incentive to clean milk production by masking the effects caused by careless methods. It was soon demonstrated that the quality of milk was not affected to any appreciable degree by this mild heat treatment and that pasteurization could not improve the quality of dirty milk since the large numbers of thermoduric organisms generally associated with such milk survived the treatment and brought down the marketable value as well as keeping quality of the product. These conclusions, as also the growing realization of the great value of pasteurization in protecting the consumers against the risk of milk-borne infections, led to its wider adoption in all countries and eventually its application for other products of milk like cream, skim milk, etc. From the commercial point of view pasteurization began to be considered as a supplementary measure for clean milk production. The efficiency of pasteurization was further enhanced by effecting improvements in the dairy plant and machinery and development of suitable tests for controlling the initial quality of milk supplies received at the depot and detecting inefficient operations or post-pasteurization contamination. The development of phosphatase test by Kay and Grahame, which can detect insufficiently pasteurized milk (variations of temperature by 1°F. or time by 5 minutes) and addition of as much as 0·1 per cent of raw milk, was a great factor in improving the efficiency of the process and raising the general quality of market milk.

Till 1900, the milk supply in the United States consisted only of raw milk. In 1906, only 5 per cent of New York City supply was pasteurized, but by 1921 the proportion had risen to 98 per cent. By 1924, 78 per cent of the fluid milk sold in communities of more than 10,000 in the United States was pasteurized. For communities over 1,000, the percentage was 69. By 1936 the corresponding figures were 83 per cent and 75 per cent respectively and by this time the incidence of milk-borne disease in the larger cities, where most of the milk was pasteurized, was practically eliminated. A survey made in 1946 showed that 277 cities had introduced compulsory pasteurization of all market milk except 'certified' milk and 192 cities required all market milk to be pasteurized. A similar expansion in the use of pasteurization occurred in Canada, England, Scandinavia, Germany, New Zealand and other countries. Thus in the United Kingdom, most of the important towns had 70 to 80 per cent of their milk supplies pasteurized by 1936. In London, the figure was over 90 per cent.

Other improvements

The process of pasteurization combined with clean milk production has played an important part in obtaining economically an abundant supply of milk, which is relatively safe for human consumption, and in improving market milk supply. Two other developments which took place early (1834-1866), namely the introduction of the glass milk bottle and application of mechanical refrigeration in the industry, completely revolutionized the methods of milk marketing. The new bottle provided a means of protecting milk from contamination after processing and thus greatly contributed towards safeguarding the supply of clean and safe milk to the consumers. Pasteurized and bottled milk began to be delivered by roundsmen moving on horse, wagons, electric trucks or gasolene trucks and in many cities such milk was also sold in retail stores. In recent years, the use of single service fibre or paper containers for distribution of milk has become popular in the United States. The use of mechanical refrigeration contributed to the rapid development of the factory system of dairy products manufacture and market milk distribution. Combined with this, the improvements effected in rail and road transport enabled milk to be shipped from producing areas as far away as 300 miles to the consuming centres. When the milk was delivered to a collecting station, it was cooled and sometimes pasteurized before being forwarded to the large towns in special milk-tank wagons, churns contained in refrigerated vans or glass-lined tank cars and even special milk trains connecting important producing areas.

All these developments together with the technical advances made in the matter of commercial sterilization of dairy utensils by the application of steam or chemical treatment, brought about enormous improvements in the production of milk on the farm, its collection, treatment and distribution by the large dairy concerns. Another direction in which the industry made great strides was in the matter of manufactured products like butter, cheese, evaporated and dried milk, butter-milk and ice-cream. Vast improvements were made in their economic manufacture as well as in their quality by a strict adherence to hygienic principles and employment of the latest scientific developments in machinery and technique.

As auxiliary steps in the successful introduction of public health control, two factors were recognized to be indispensable, viz. education and economic improvement of the dairyman. Education of the dairyman was recognized to be an essential pre-requisite for preparing him to understand and appreciate the need for official regulation of his business. The rapid advance made in the United States and England is in no small degree due to the educative propaganda, clean milk competitions and instructional courses carried out in these countries by agricultural and public health authorities, scientific institutions and trade and professional associations.

Economic inducement has been another potential factor in determining the improvement of milk supply. The production of clean milk with a high fat and vitamin content is undoubtedly more expensive than that of milk produced from poor and improperly fed stock, without any regard to hygienic precautions. Unless the producer receives a reward commensurate with the pains he takes in the production of milk and unless he gets sufficient returns for his labour and expenditure he would have no incentive to produce more and better milk. This principle has been recognized very early and in all movements for improving the quality of market milk, primary attention has been paid firstly, towards the economic improvement of the producers by providing suitable facilities for the disposal of his product either in the liquid form or for manufacturing purposes and regulating the prices accordingly and secondly, towards stimulating his interest in producing milk of higher quality by offering higher prices or premiums for quality. From the earliest times, the commonest method of quality payment has been to regulate the price according to the butter fat content of the milk. In course of time, systems of allowing premiums on cleanliness (usually some percentage of the milk price) came into prominence and did much to stimulate interest in attaining higher standards of quality of liquid milk sold in the market. In one method, sharply defined standards of cleanliness and other conditions are prescribed for two or more grades of milk and a fixed rate of payment is attached to each class. This has been the principle on which the grading of market milk has been effected. In another system (e.g. payment of bonus under the Milk Marketing Scheme in England) all producers conforming to certain regulations are paid bonuses at a uniform rate, or the farmers are periodically rated on the basis of the quality of milk and paid premium on a sliding scale. All these price adjustments are made between the producers and buyers (dairies, milk marketing boards, and other agencies) and the latter supply the public with a single grade of milk at a uniform price. In some countries, special grades of milk (e.g. 'certified milk' in the United States) are sold to the public at prices higher than those of ordinary milk. In order to protect the producer from fraudulent competition, milk of this sort had to be given a distinct label and sold under licence. In recent years, the system of supplying graded milk to the consumer is not favoured. The quality payment should be a matter of arrangement between the producers and the buyers and the latter should supply the highest available grade to the consumers, diverting the inferior classes of milk for manufacturing purposes.

Laboratory control

Along with the advances made in the technique of milk production and the introduction of official measures for controlling market milk supply, scientific methods of assessing the quality of milk and improving the same have been developed after considerable research and experimentation. The early introduction of reliable laboratory tests has been a very important step in the successful formulation of milk control policies in all countries since such tests have played an indispensable part in achieving the following objectives:

(i) Classification or grading of milk into different categories according to the bacteriological standards prescribed for the purposes.

(ii) Exclusion of unsatisfactory supplies in bulk milk destined for liquid consumption, processing or industrial utilization.

(iii) Prevention and correction of faulty methods of milk production and handling at all stages.

(iv) Payment of prices on quality basis as a financial inducement to the producer or distributor to supply milk of the highest standard.

A technical description of the various methods adopted for the purpose, e.g. fat content, specific gravity, vitamin content, cleanliness, keeping quality, safety and pasteurizability would be out of place here. Fat test (first introduced in the United States by Babcock in 1878) was the earliest method used for checking the quality of milk and its adoption was mainly instrumental in facilitating the purchase and disposal of large volumes of milk on a business scale. Specific gravity (lactometer test) was extensively employed for detecting addition of water in milk but in recent years, the determination of freezing point of milk has been accepted as the most reliable test for the purpose. In assessing the cleanliness of raw milk, the principal methods employed have been the sediment test, microscopical examination, plate count and coliform test. The sediment test has been of value in the control of dirty milk, but it affords little information once the general standard of cleanliness among producers has been raised to a reasonably high level. Microscopic examination enables the drawing of a rapid distinction between milk containing few and those containing large numbers of bacteria and it has been officially recommended in the United States, mainly for use at receiving stations, where it is important to prevent dirty milk from being mixed with clean milk. It, however, requires expensive intitial outlay and well-trained workers to interpret the results. Plate count and coliform tests have been two of the oldest methods used in water and milk analysis. The former is a complex, time-consuming and expensive method, difficult to standardize and accompanied by large experimental errors. The coliform test, which seeks to indicate manurial and faecal contamination and therefore of great importance from the public health standpoint, is of doubtful value in the case of milk, since other types of coliform organisms derived from plant sources freely occur in milk and multiply very rapidly, giving a false indication of the original condition of the milk. The grading systems in all countries were formerly based on the plate counts. As a result of the critical examination made by Wilson and his collaborators (British Medical Research Council) regarding the different methods of milk examination and their value in the grading of milk, the methylene blue reduction test was introduced for the routine grading of raw milk in England from 1937. The plate count was continued to be used only for examining pasteurized milk and for special investigations.

The methylene blue reduction test is based on the principle that methylene blue is reduced to a colourless stage as a result of bacterial activity in milk and the reduction time depends not only on the numbers, but also on the activity of the organisms in the milk, that is to say, on the two factors which mainly affect its keeping quality. The test has a very low experimental error, is simple and gives results in five to six hours. It has accordingly been widely accepted as a useful method in the bacteriological analysis of milk and officially employed in England for the periodic testing of designated milk which receive higher prices. Recently, the resazurin reduction test has become very popular as a more rapid and discriminating method of testing milk. In this test, resazurin undergoes a series of colour changes from blue to pink and then to a colourless form as a result of bacterial activity. It is also susceptible to the influence of leucocyte cells generally associated with abnormal milk (colostrum, advanced lactation milk and milk derived from diseased udders). By observing the colour change at a particular time or the time required for attaining a particular shade of colour, the quality of milk is judged. The test is not only rapid, but it also detects both high count milk as well as abnormal milk (which are considered to be unsuitable for cheese-making and other purposes). It has been subjected to considerable verification throughout the world and exhaustive trials carried out at the Indian Dairy Research Institute, Bangalore, have borne out its usefulness for adoption in India.

The resazurin test is now officially employed in England (under the National Milk Testing and Advisory Scheme) for determining the keeping quality of producer's supplies mainly with a view to direct assistance and advice to those farms where it is most needed. A modification of the resazurin test (ten minutes test) is used as a rapid platform method of eliminating very bad quality milk from being bulked with cleaner milk. The introduction of these two tests helped the country in tiding over the difficulties caused during war time and in improving the general quality of market milk. Formerly the acidity test, according to which high acidity in milk was regarded as an indication of bacterial growth, was being used as a simple and rapid method of detecting the quality of milk supplies on the receiving platform. With the recognition that high acidity may be due to the initial acidity of the milk itself (particularly while handling small quantities of milk) and that the deterioration of milk may be brought about by proteolytic bacteria without increasing the acidity, greater emphasis has been placed on the use of more reliable methods like the rapid resazurin test.

As regards determining the safety of milk, no routine test has been evolved as in the case of drinking water. Occasionally tests for hemolytic streptococci, tubercle organisms and *Brucella abortus* are carried out which require the application of special methods. On the other hand certain simple tests, e.g. brom cresol purple paper and strip cup tests, are recommended for routine adoption in the farm for detecting animals suffering from mastitis or other udder troubles. The plate count and other bacteriological tests, which reflect the sanitary standard of milk production, provide some indirect evidence regarding the safety of milk, but chief reliance is placed on efficient pasteurization of milk before delivery to the consumer. The efficiency of pasteurization and any faults in the operations are now determined by means of the phosphatase test, and the half-hour methylene blue test is used for detecting post-contamination. Increasing importance is also being given to the use of laboratory pasteurization test, which determines the number of heat-resistant flora in milk and therefore its suitability for pasteurization (or ' pasteurizability ').

A number of laboratory tests have also been evolved for assessing the sterility of dairy utensils, for finding out the suitability of milk for transport, or for cheese making, and condensing and for examining the quality of cream and other milk products, all of which have been of value in improving the milk industry.

CULTIVATION OF ROSHA GRASS IN THE PUNJAB

By GHIAS-UD-DIN AHMAD and ASA SINGH THIND

ROSHA grass (*Cymbopogon martini* Stapf. *var. motia*), a perennial grass, belongs to the family gramineae, and yields the essential palmarosa oil of commerce on distillation. The palmarosa oil was for a long time distilled by indigenous methods from the grass growing in wild state in Khandesh in the Bombay Province and Nimar in Central Provinces. The oil was exported from Bombay to Turkey and from there to Paris, where it was used in the manufacture of geraniol, the chief oderiferous constituent of the otto-de-rosa, and base of artificial rose odours as well as a better adulterant for otto-de-rose. At present this oil is mostly exported to the United States and England. The figures in Table I show the export of the oil to foreign countries by sea from British India in pre-war days.

TABLE I

Quantities of otto-de-rose exported and value thereof

Year	Gallons of oil	Cost
1934–35	10,045	Rs. 2,75,633
1935–36	10,437	Rs. 2,79,702
1936–37	8,129	Rs. 2,36,977
1937–38	10,837	Rs. 4,13,413
1938–39	6,642	Rs. 2,34,305

Note: Figures prior to 1937-38 relate to British India including Burma.

Pioneer work

The Punjab Government took the initiative in introducing the cultivation of rosha grass in the province in 1924. An area of 385 acres on upper Chenab canal in Sheikhupurah District, about 35 miles from Lyallpur, was granted on lease to Professor Puran Singh for a period of five years in the first instance, on the condition that he put 231 acres under rosha grass during this period. The lessee experienced many difficulties, particularly of water supply, in successfully cultivating the grass on his area. The lease was renewed for a further period of five years in 1929. Professor Puran Singh had to spend a large amount of money for bringing the barren land under cultivation and on buying the distillation machinery. He suffered a big loss on account of a fall in the price of the oil and because of a heavy initial expenditure. He, therefore, gave up the lease in 1931 and the Rosha Grass Farm was placed under the charge of Professor of Botany, Punjab Agricultural College, Lyallpur. In December, 1936, the Farm was given over on lease to Dr C. Khuda Dad, a Chemist at Dehra Dun, who ran it successfully and subsequently bought the plantation.

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Rosha grass belongs to the genus *Cymbopogon*, a genus of grass that contains some forty species, widely dispersed in the tropics, particularly in the old world. Only aromatic species of the genus are of chief economic importance. *Cymbopogon martini* is an important aromatic species, and has two varieties, *motia* and *sofia*. The variety *motia* is white-flowered and yields superior palmarosa oil of commerce while the second variety, *sofia*, has bluish flowers and gives ginger grass oil, which is an inferior oil and is used as a perfume in soap. A type of *motia* variety which flowers early, that is, in October and possesses medium thick stalk with very dense inflorescence and grows to a height of about five feet is a very good type as it yields the maximum amount of oil.

Soil

A loamy soil is best suited for the cultivation of this grass. It can, however, be grown successfully in well-drained clay soil, if there is no water-logging. If the soil is not well-drained or after a heavy irrigation the water remains standing in the field for a number of days, especially in the hot weather, the growth of the grass is adversely affected.

Preparatory tillage and sowing

Preparatory tillage includes four to five ploughings. After *rauni* (watering before cultivation) the land should be ploughed and ridges made two to three feet apart in *vattar* (wet condition of soil).

Rosha grass can be raised directly from seed or from nursery plants. If the supply of water is liberal, seed may be sown directly in the prepared soil on ridges two feet apart during March-April. The seed should be dibbled on the top of the ridges at a distance of nine inches from one another. As the seed is small, some earth may be mixed with it. Five pounds of seed are required for sowing one acre. After sowing irrigation is done. At places where a liberal supply of water is not available, the seed is sown in a nursery in February-March. The seedlings take about one and a half months to be ready for transplantation, when a group of plants is removed along with earth balls and is planted on ridges in April-May and water is applied afterwards. At places where rainfall is sufficiently high, sowing may be done in June, so that the plants start their growth with the onset of monsoons.

Irrigation

Water is a limiting factor in raising a successful plantation of rosha grass. Under irrigated conditions, supply of water should be liberal. The grass requires irrigation after every 10 days during the growing season and should never be allowed to suffer on account of drought. With ample supply of water, growth is luxuriant, but if drought conditions prevail, the growth is checked, leaves wither and the oil content is reduced. Water-logged conditions are, however, harmful. The new growth starts in February and irrigation should be frequent in early part of the growth, and at the time of distillation, i.e. in October and November, irrigation should be withheld. The grass reaches full maturity by October and is then soon harvested and distilled.

Under rainfed conditions, it can only be grown where rainfall is about 100 inches and is well-distributed throughout the growing season.

Hoeing and weeding

A large number of weeds generally appear in grass fields. Rosha grass being perennial, the intensity of weeds increases every year. No undesirable vegetation should be allowed to flourish in the field. Seeding of one day is weeding of years. So from the very beginning hoeing and weeding should be done to check the weeds and provide conditions for the proper growth of the plants so as to make the plantation an economic success.

Manuring

Rosha grass is perennial and in order to stimulate tillering, it is necessary to replenish the soil. In rich soils, manuring may not be needed for the first one or two years. By manuring rich soils, the stems become thick and the yield of oil is reduced. When the grass becomes dense, the fertilizers encourage growth and production of more shoots. In poor soil there are less number of tillers. In order to get good yield of oil, it is very essential that farmyard manure or some other fertilizer is applied during winter.

Harvesting

The grass should be harvested for distillation when it contains the maximum amount of oil. It has been found that at the time of flowering, that is, in October, the plants contain the maximum quantity of oil in leaves, stems and flowers. The crop should be harvested in October and should be distilled as it comes from the field. It has been found that loss in the oil-content of the stacked grass takes place during the first two weeks of stacking, after which the oil content remains practically constant. The whole plant yields the maximum amount of oil about a week after flowering, i.e. from the fourth week of October up to the third week of November. Frost reduces the oil content of the plants. So the crop for distillation purposes should be harvested before the onset of frost. If it is not possible to distil the whole lot before frost, the grass should be cut and stacked. At any rate the grass should not be allowed to stand after the middle of December. Two cuttings can be taken if the soil is very rich, viz. in July when it is not flowering and in October-November. But as a general rule only one cutting is taken in October-November.

The grass stumps after harvesting dry up in winter. So thorough weeding and hoeing should be done in January and the dry stumps of rosha grass should be burnt.

Oil content of the plant

Leaves: The essential oil content of the leaves ranges between 1·20 to 1·30 per cent of the dry weight in the month of September and gradually rises to a maximum of 1·39 per cent by the middle of October, when flowers appear, after which it shows a gradual decline till the end of November. After frost the oil content shows a further decrease, the net loss being 13 per cent of the maximum oil content. With a further advance in the season the oil content gradually falls to a minimum of 0·77 per cent by about the beginning of March, thus showing decrease of about 45 per cent from the maximum. Leaves yield the highest amount of oil throughout the season.

Stalks: Oil content in stalks is negligible, being 0·03 per cent only (on dry weight basis) during the month of September. With the advance of season, they become more thick and tough. So they give the least amount of oil.

Flower heads: The essential oil content of the flowers, reaches a maximum of 1·37 per cent (on dry weight basis) by the end of October and then declines. The oil content shows a sudden decline after frost, a figure of 0·59 per cent by the second week of January, when it falls still further, showing at this time a total decrease of 59 per cent from the maximum. Flowers are short-lived and give maximum amount of oil, a week after their appearance. The oil content in the entire plant ranges from 0·15 per cent to 0·22 per cent on the fresh weight basis and 0·27 to 0·40 per cent on dry weight basis. The period of maximum oil content in the entire plant synchronizes with that in the leaves and flowers. As a result of frost, a decrease of 32 per cent in oil content is noticed in January and 54 per cent in March.

Distillation

The palmarosa oil of commerce is extracted in two ways from the plants, viz. (1) country method of distillation and (2) steam distillation.

Country method of distillation: The grass is cut into pieces or loosely packed as such in a vessel containing ample water. The vessel is heated. Oil as well as steam pass through a retort and are collected in a receiver placed in water. Condensed oil floats on water and is removed with the help of a separating funnel. The same grass from which oil is extracted can be used as fuel for heating after drying for two days.

Steam distillation: Grass is placed in an iron cylinder and packed. The cylinders are fitted with lid which can be screwed down tightly. Steam is let into the cylinders from a boiler. Steam as well as oil pass through copper coils fitted to condensing vessels. The contents are collected in a receiver and the oil is decanted. The oil as recovered in the condensing vessel is dark in colour. It is, therefore, filtered through coarse blotting paper, and a clear, light yellow coloured oil is obtained.

Yield of the oil

The yield of green grass varies from 60 md. to 150 md. per acre. The yield of oil depends upon the quantity and quality of the grass. The average yield of oil at Jaranwala was about 15 lb. per acre. The price of oil has been varying. The pre-war price was about Rs. 3 per lb. but how it has gone up to Rs. 25 to Rs. 30 per lb. The pre-war cost of production of 1 lb. of oil was Rs. 1-8 and now-a-days it is about Rs. 4 per lb. An average annual gross income from a square (25 acres) of plantation in these days is about Rs. 7,500 and it can rise still higher with good cultivation.

SUGAR REQUIREMENTS IN CANDYING OF FRUITS AND PEELS

By GIRDHARI LAL and NAGINA LAL JAIN

CANDYING is a method of preservation in which fruits are preserved by impregnating them with enough sugar to prevent spoilage. For this purpose, they are treated in sugar syrup until they absorb sufficient sugar; the fruits are then drained and dried. In order to have proper and maximum absorption of sugar and for getting a product of standard quality, slow rate of absorption is essential. This is achieved by starting with a syrup of low sugar concentration, which is increased gradually till the final concentration of about 75° Brix is reached. This process prevents the breaking and shrivelling of fruits and peels.

For keeping the fruits or peels completely submerged in sugar syrup, large quantities of the latter are required during the process. Although this necessitates the use of a good deal of sugar, only a portion of it is actually absorbed by the fruit while the rest is left unused in the surplus syrup left over after the process, and can be re-used. For purposes of commercial manufacture of candied fruits, it is important to know the total requirements of sugar syrup for the candying process and the sugar actually used in the finished candied product. Such data are not available in the literature on the subject. In order to collect this data for the guidance of the manufacturers, experiments were carried out on the candying of the most common fruit material used for candying in this country, viz. citrus peels (orange and lemon), carrots and ash gourd (*Benigosa Cerifera*)—a variety of pumpkin commonly known as *petha* in this country. Incidentally, details of the methods for the successful candying of carrots and *petha* have been collected. The present article deals with the results of the investigation carried out in the light of the above remarks.

Method of candying fruits and peels

The method for the candying of orange peels has already been standardized in the laboratories of the Indian Institute of Fruit Technology, Delhi. The method which is briefly described below was used for candying orange and lemon peels in this investigation. With slight modifications, this was also adopted for candying of carrots and *petha*.

Preparation of fruits and peels: After extraction of the juice from the halved oranges and lemons, the pulp and rag sticking to the inside was removed by scooping with special spoon-shaped stainless steel knives. Carrots were peeled by scraping with knives, and then cut lengthwise into ¾ in. to 1 in. thick pieces. *Petha* was cut into halves, which were further cut longitudinally into pieces of desirable thickness (about 1 in.). These were peeled carefully to remove all the hard greenish rind and also seeds and soft portions of pulp. These pieces were further cut crosswise into smaller pieces of desirable dimensions for candying; or these may be cut into cubes in a cubing machine.

Preliminary treatments: Orange and lemon peels and carrots were after preparation allowed to undergo 'salt curing' fermentation by immersing them separately in 2·0 per cent brine (common salt solution) and daily increasing the salt concentration by 2·0 per cent until it reached 8·0 per cent. Then they were removed and kept in fresh 8·0 per cent brine (containing 0·2 per cent added potassium metabisulphite) for about 10 days in case of carrots, and for about 5 weeks in case of peels, till they acquired the proper softness necessary for subsequent processing.

Slices of *petha* after preparation as above, were kept immersed overnight in lime water (saturated solution of quick lime in water) to harden them.

The peels and carrots and also *petha* slices after removal from brine and lime water respectively, were washed thoroughly in running cold water to remove the excess of salt or lime. They can, with advantage, be flushed with warm water (100°F.), to hasten the washing process. After thorough washing, they were boiled or blanched gently in water to soften the

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tissues for proper absorption of sugar. This also helped in removing the last traces of salt or lime. The range of boiling periods given below gave desirable results in experiments carried out in these laboratories:

Citrus peels (orange and lemon)	15 to 20 minutes
Carrots ..	5 to 7 minutes
Petha ..	30 to 60 minutes

Note: Blanching time would vary with the maturity of carrots and *petha* in particular.

Blanching in each case was followed by cooling in cold water and then draining thoroughly. After this, they were pricked with copper or bamboo needles, or stainless steel forks (as the use of ordinary iron needles blackens the fruit tissues), in order to allow proper penetration of sugar syrup and to prevent shrinking of the skin.

Candying process: The use of cane sugar (sucrose) alone in candying results in undesirable crystallization of sugar and hardening of fruit tissues in the finished product. To overcome this trouble and also to have a final product of desirable soft texture and glossy appearance, the candying process is best carried out in a sugar syrup containing sucrose and invert sugar in the proportion of about 1 : 1. The proportion of invert sugar in the candying syrup is made up in foreign countries, by the addition of required amounts of glucose or invert sugar syrup, which being a by-product of the corn industry, is available at cheap rates. Since it is not available in any large quantities in our country, the desired amount of invert sugar can be produced in the sucrose syrup itself by partial inversion of the sucrose. This process has already been mentioned in the literature on the subject in the United States and has been used as a commercial success in our laboratories, for candying of citrus peels, after experimentation under local conditions.

For starting the candying process, a syrup of 30° Brix was prepared by dissolving 30 lb. sugar in 70 lb. water. This, after straining through cloth was boiled for about 12 minutes with about 1½ oz. added citric acid. This quantity of acid produced an acidity of about 0·1 per cent in the syrup, which converted about 50 per cent of the sucrose into invert sugar during boiling and yielded a final syrup with the following composition:

Per cent total sugars (Brix at 68°F) ..	37·50
Per cent invert sugars ..	19·20
Per cent acidity (as citric acid) ..	0·11.
Per cent inversion ..	51·20

The concentration of the syrup increases from 30° to 37·50° Brix after boiling. But when this syrup comes in contact with the fruit during the subsequent process, its concentration again reverts to almost the original level due to incorporation of water of the fruit with the syrup and the absorption of the sugar of the syrup by the fruit.

Both orange and lemon peel halves after blanching and draining were put one inside the other all round in a vessel in which syruping was to be carried out. *Petha* slices and carrots were closely packed. Hot sugar syrup (immediately after boiling), prepared as above, was then poured over the peels or fruits, which were kept pressed down by means of a rack of a non-corrodible material, so as to keep them immersed in the syrup. Such an amount of syrup was used in each case as was just sufficient to keep them completely covered. After 24 hours, the fruit was drained and the concentration of the syrup increased by 5 per cent in case of peels and carrots, and 10 per cent in case of *petha* over that on the previous day, boiled similarly for 10 to 12 minutes and again poured over the fruit. This was repeated every day till the candying syrup attained a concentration of 60° Brix in each case, after which the above process was repeated on alternate days up to the final concentration of about 75° Brix.

In commercial practice, traces of salt may still be left in the fruit even after blanching, which will be extracted in the syrup on the first day. It is, therefore, advisable to continue the above process after the first day in a freshly prepared syrup of the desired composition; the syrup drained after the first day should preferably be used for starting the candying process in a fresh lot of fruit.

During the progress of the candying process, the candying syrup was daily analyzed for total and invert sugars and acidity. The acidity was maintained at 0·1 per cent level, by further addition of acid if necessary, up to a stage when density of the syrup reached 60° Brix. After this, acid was added only when necessary, to keep it at a minimum of 0·05 per cent. The proportion of 1 : 1 between sucrose and invert sugar of the syrup was adjusted throughout the process by increasing or decreasing the period of boiling the syrup (in presence of the above quantity of acid) before pouring over the fruit. This period was increased when the amount of invert sugar decreased below 50 per cent level and *vice versa*.

In case of citrus peels, the proportion of 1 : 1 between sucrose and invert sugar of the syrup could be easily maintained to a fair degree by the method of chemical control outlined above. With carrots and *petha*, however, a little difficulty was experienced in this respect. The proportion of invert sugar in their case remained rather low even with an increased boiling time of the syrup, which is likely to adversely affect the quality of the syrup as well as the finished product. This may be attributed to the presence of some buffering substances in them. Short salting process in case of carrots and complete elimination of salting process in case of *petha*, may also be contributing factors to this trouble. In such a case, the proportion of invert sugar in the candying syrup can, with advantage, be made up by adding to it appropriate amounts of sucrose and glucose or invert sugar syrup of about 80° to 90° Brix concentration to raise its sugar concentration to the next syruping stage.

Finishing : After the candying syrup reached its maximum concentration of 75° Brix, the fruit was allowed to remain submerged in it for a further few days before it was removed for finishing. On removal from the syrup, it was drained thoroughly on a wire gauze screen to drain off all the excess syrup. Then it was spread on wire gauze trays and kept exposed to room temperature for a day or so for drying and finally packed in friction top tins.

Requirements of sugar for candying

Total sugar requirements : Complete data in respect of experiments carried out on the candying of orange and lemon peels, carrots and *petha*, are given in Table I.

TABLE I

Total requirements of sugar during candying of fruits

(The total quantity of sugar syrup required to submerge the fruit completely, varied with the shape and structure of the material handled)

Treatment of fruit	Orange peels		Lemon peels		Carrots		*Petha*	
	10 lb.		10 lb.		10 lb.		10 lb.	
	lb.	oz.	lb.	oz.	lb.	oz.	lb.	oz.
1. Amount of 30° Brix sugar syrup required to start the candying process on the first day	24	$9\frac{1}{3}$	25	$8\frac{1}{3}$	14	$14\frac{5}{9}$	21	$12\frac{1}{3}$
2. Sugar required to prepare the above syrup	7	6	7	$10\frac{1}{2}$	4	$7\frac{2}{3}$	6	$8\frac{1}{2}$
3. Sugar required during subsequent days, to gradually increase the concentration of candying syrup up to the end of the process (75°Brix concentration)	19	5	16	$2\frac{1}{3}$	9	$5\frac{1}{6}$	16	$7\frac{1}{2}$
4. Total quantity of sugar which was required to complete the process (total of 2 and 3 above)	26	11	23	$12\frac{5}{6}$	13	$12\frac{5}{6}$	23	0
5. Amount of candy obtained after drying	12	0	10	9	10	0	13	$2\frac{1}{3}$
6. Total quantity of sugar required for preparing 1 lb. of the finished candied product	2	$3\frac{3}{4}$	2	4	1	6	1	12

It is seen that in typical candying experiments as given in Table I, a total quantity of about $2\frac{1}{4}$ lb. sugar was required for making syrups for the process in case of citrus peels, so as to obtain 1 lb. of the finished candied product. Amount of sugar similarly required in case of *petha* was $1\frac{3}{4}$ lb. while in case of carrots, it was $1\frac{3}{8}$ lb.

Sugar actually used in candying: The actual amount of sugar taken up by the fruit during candying was determined by the analysis of the surplus syrup left over at the end of the candying process in each case. The data thus collected are given in Table II.

TABLE II

Amount of sugar actually used in candying

	Orange peels	Lemon peels	Carrots	*Petha*	Remarks
1. Total amount of sugar which was required to complete the process (lb.)	26·69	23·80	13·80	23·00	Table I, item (4)
2. Amount of syrup recovered at the end of the process (lb.)	20·50 (78·0° Brix)	19·17 (78·0° Brix)	7·92 (69·0° Brix)	16·52 (77·2°Brix)	Actual estimation
3. Total amount of sugar recovered in the surplus syrup (lb.)	15·99	14·95	5·46	12·75	Calculated from item (2) above
*4. Sugar actually used in candying the fruit (i.e. absorbed by the fruit) (lb.)	10·70	8·85	8·34	10·25	Item (1) above *minus* item (3) above
5. Candy produced (lb.)	12·0	10·60	10·0	13·15	Table I, item (5)
*6. Sugar actually used in preparing 1 lb. of the finished candied product (i.e. sugar absorbed) (oz.)	14·25	13·36	13·34	12·47	Item (4) above divided by item (5) above

*Items (4) and (6) also include wastage during the process, as some wastage is always liable to take place in commercial manufacture.

It is clear from the above data that roughly 12½ to 14¼ oz. sugar (including some wastage during the process of candying) would actually be required for preparing 1 lb. of the finished candied product, the rest of the total amount used in the process, is recovered as syrup which can be re-used.

DECENTRALIZATION IN COOPERATIVE CANE UNIONS, UNITED PROVINCES

By MAHADEO PRASAD

THE Cane Development Department has been subjected to criticism from various quarters particularly in respect of the standard of cane cultivation and irrigation facilities, survey of cane crops, estimates of cane yield and supply of cane by the Union to various mills. The relation between the mills on one hand and the staff of the Cane Development Department or of the Union on the other remains strained for one reason or other, particularly because many factories do not get cane sufficient for their crushing capacities. The factories, therefore, put the whole blame on the Cane Development Staff or the Unions. While the Cane Development Department with a meagre staff provided to it for dealing with lacs of cane-growers in the province did its best, there is no doubt that much remains to be done. There has been a continued demand for provision of more staff, but it is to be admitted that a huge staff would increase the volume of expenditure. The protection given to the sugar industry cannot be expected to last long and the industry has to stand on its own legs. We have to find out some means for cutting down the expenditure and bringing it down to the minimum.

Setting up of panchayats

The remedy lies in utilizing the services of the representatives of cane-growers. So far they have been given some rights but without any obligation. The village field staff at present give advice to the growers and sometimes do the work which the growers should do themselves. The paid staff cannot be expected to carry on that work for such a large number of growers. Experience has shown that when the staff left the village the growers did not carry out the instructions given, even though these were for their own good. Moreover there was no one left to supervise their work. It is here that the village *panchayat* comes into the picture; it can see to it that the instructions given by the staff are carried out. The byelaws of the Cane Unions provide for the formation of *panchayats* for each village to be elected by the members and these *panchayats* are entrusted with various functions. The *panchayats* should be given some powers under the byelaws and should at the same time be saddled with certain responsibilities. Where necessary, small sub-committees may be formed for different types of work. Such decentralization will curtail the need for additional staff. So far as the Central Cane Union is concerned, it is run practically by the staff of the Assistant Cane Development Officer. The elected Directors legalize the various actions of the staff. It may be alright so far as the centre is concerned but the main cooperative effort in the villages has not yet been touched. As a rule, the work of village organizations should be taken up first. The village units should make a central union—even though this requires a very long time. In the United Provinces, however, the work was tackled the other way in order to accelerate the pace of progress. The Central Union was established first to give the necessary incentive to the cooperative movement.

The officers of the Department have been afraid of entrusting the work of cane supply to the village people lest this arrangement should lead to a breakdown in the supply link and consequent stoppage of work in mills. Such fear was no doubt justified in the initial stages but certainly not after the lapse of several years. The villagers with a little training should be able to manage their *panchayats*, and the Government staff should only serve to guide the *panchayats* and supervise their work. As Cane Development Officer in the eastern districts, I had taken the risk of giving the scheme a trial in selected circles and villages by entrusting the cane supply work to the *panchayats* and the results were quite encouraging. In some cases the *panchayats*

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declined to take up the work for fear of getting into trouble and in a few cases they abused the power given to them. In the latter case, the power was withdrawn and later some of them repented for their mistake and asked for its restoration. There was also a demand for such a scheme from quarters in which it had not yet been tried. These instances only prove that decentralization has every chance of success and would reduce the present complaints to the minimum. With better organized work the improvements effected would be more appreciable and the relations between the mills and the cane development staff of the Union are bound to improve.

Merits of decentralization

The merits of decentralization are noted below.

Standard of cane cultivation : At present it is only the Supervisor and *Kamdar*, headed by Assistant Cane Development Officer, who are responsible for improving the standard. As the staff is meagre and the number of growers large, it is futile to expect that all the growers would agree to adopt all the improved methods recommended. The *panchayat* of each village should be held responsible for acts of omission or commission of each grower. The defaulting member can be brought to book by the *panchayat* under the byelaws of the Society. The *panchayat* should carry out the instructions given by the cane development staff and see that all the members follow the programme chalked out for each village.

Distribution of seeds, manures and implements : The *panchayat* should assess the requirements of village for seeds, manures and implements and make recommendations to the Union for the supply or loan of these articles. At present the Union deals with each member direct. In case of decentralization it has to deal with each village, leaving the details to be worked out as far as possible by the *panchayat*.

Arrangement of nurseries : The *panchayat* should help the staff of the Cane Development Department in looking after the nurseries properly.

Irrigation facilities : The *panchayat* should be encouraged to initiate proposals for the village under its charge particularly for joint sinking of wells on the lines which might be indicated by the Department.

Pests and diseases : It should be the duty of the *panchayat* to report the outbreak of diseases or visitation by pests promptly and to follow the general directions given in such cases.

Estimates of yield : At present the *Kamdar* records the yields of crops rather haphazardly. Records should be prepared in consultation with the *panchayat* which should be responsible for the accuracy of data.

Regulated supply : According to the present practice the Union at the centre makes a requisition for cane from each individual member direct and this important work falls on the large number of low-paid *Purzi Muharries* who hold seasonal jobs and are often unreliable. Because of the enormous volume of work, the chances for corruption are many. The requisition slips are issued on the basis of the figures supplied by the *Kamdars*, and it has been found that their figures abound in inaccuracies. Again, the *purzi* distributor is required to deliver the requisition slips to the members personally but in practice he usually entrusts the work to some one else. In many cases when the grower for whom the slip is meant is not available, or is somehow unable to take the cane on the fixed date, the regulation of supply is adversely affected. Cases are not uncommon when the slips continue to be issued to a grower who has actually no cane left. The suggestion, therefore, is that the Union should send *purzis* with the name of village duly recorded thereon, keeping the name of individual grower blank to be filled up by the *Surpunch* or *Punch* specially entrusted with this duty. The *purzi* distributor will have to deliver all the slips for the village to its *Surpunch* or *Punch*. This would make his work easier and the expenditure at present incurred for this purpose would be curtailed. A supply calender prepared by the *Kamdar* would be handed over to the said *Surpunch* who should be required to place a tick mark against the grower to whom the slip is issued, to note the name of such person on that slip and to pass it on to him in the village. If the particular person is not available or cannot supply cane on the fixed date, he can make necessary corrections at once. A little training in the procedure of issuing slips and in marking is necessary and one who is literate should be entrusted with this work. It is not difficult to find such literate persons in a village. For a few years it would be desirable to maintain similar calenders for all the villages in the Union as is done at present and it should be ensured that the *panchayat* is carrying out the work properly. As soon as it is found at the Centre that the *panchayat* is not working as it should, the power given to it could at once be withdrawn and the slips could be issued direct to the growers without affecting the supply adversely. In such cases members would be able to turn out an undesirable *Punch* and replace him by another. The Assistant Cane Development Officer would no longer have to face so many visitors for *purzis* at his office and would be free to move about for development work and to supervise the work of village *panchayats*.

TOMATOES FROM CUTTINGS

IN the Gosford district of New South Wales, Australia, a grower has pioneered the commercial development of tomatoes from cuttings. His method is particularly suitable for establishing late crops, and is most successful in sandy soils.

Cuttings are taken either from an earlier planted bed or from plants started for the purpose. By using cuttings, it is possible to make selections from the best plants by choosing good-yielding and disease-free types, and, at the same time, to establish a crop quickly. It is best to strike the cuttings in nursery beds, and then transfer them to the permanent location.

Yields are equal to, if not better than those from plants grown by the standard method of raising seedlings.—*Australian Agricultural Newsletter*, No. AGN/192.

THE SEVENTH ALL-INDIA CATTLE SHOW

THE All-India Cattle Show was held this year under the shadow of a tragedy of unprecedented magnitude caused by the death of one of the world's greatest men. As in every other sphere of activity, this event caused a deep gloom over the Cattle Show. Rajghat, which is now known all over the world as the sacred spot where the mortal remains of the departed soul are laid, is the place where the Cattle Show was held during the previous year and where arrangements were in progress for holding the Show this year. The venue of the Show had to be shifted towards the north by a few yards because of this unexpected event. The choice of Rajghat as the burial place may be an accident, but it has proved to be in the fitness of things and has immortalized the Mahatma's association with the cow and his interest in the development of the cow as an economic animal.

The Show was held between 16 and 25 February 1948 and was formally opened on 20 February by Shri Jairamdas Daulatram, the Hon'ble the Minister for Agriculture. In welcoming the Hon'ble Minister, Sardar Bahadur Sir Datar Singh, Vice-Chairman of the Indian Council of Agricultural Research traced the history of the All-India Cattle Show, explained its aims and described its activities, which were to further cattle improvement and to spread the knowledge of the principles of breeding good cattle. In a feeling reference to Mahatma Gandhi, Sir Datar Singh referred to his affection for the cow and his interest in her development. Declaring the Show open, the Hon'ble the Minister for Agriculture delivered a comprehensive address emphasizing the importance of the cattle problem with which the health and wealth of the nation were intimately connected. The inadequacy of cattle feeds and the paucity of good breeding bulls were mainly responsible for the present appalling inefficiency of the cow. Her capacity to produce milk and bullocks could be improved only by organized efforts to fill the gap between availability and requirements of both feeds and bulls. He made a number of valuable suggestions for increasing the quantity of cattle feeds and for improving their quality. In the matter of bulls the gap was much wider, the available supply being only 1 per cent of the requirements. The establishment of key villages as envisaged in the I.C.A.R. Scheme, was emphasized in this connection.

The Show consisted of 440 cattle, 300 poultry and a few sheep and goats. The cattle came from all over India and consisted of the well-known Indian breeds, Amritmahal and Hallikar from Mysore, Kangayam and Ongole from Madras, Kankrej, Gir and Nimari from Bombay, Hariana, Murrah, Nili and Ravi from the Punjab, Gaolo and Malvi from Central Provinces and Berar and Bhagnari from Nabha. There were also representatives of the Pakistan breeds, Sahiwal, Sindhi and Tharparkar, exhibited from the herds of these breeds located in India. One of the worst consequences of partition has been the cutting off of these three important breeds from the Indian territory. They are used all over India either for pure breeding or for grading up of local inferior cattle in several parts of the Indian Union. The large numbers in which breeders in Sind and West Punjab used to exhibit them in previous years were conspicuous by their absence this year.

The Poultry Show, consisting of 300 birds, represented the three breeds—Rhode Island Reds, White Leghorn and Black Minorca. This Show is usually held for three days only and was closed on 22 February. Mr. B. R. Sen, Secretary to the Government of India, Ministry of Agriculture, distributed the prizes. As many as 25 trophies and cash prizes amounting to Rs. 905 were distributed. H.E. the Governor General's Cup for the best bird in the Show was won by Mr. E. G. R. Hixon of Ajmer for his Rhode Island red cockerel.

The prizes for the Cattle Show were distributed on 25 February by the Hon'ble the Prime Minister in the presence of a distinguished gathering and a large crowd of visitors. In his address to the gathering he compared Indian cattle with cattle in other countries which he had visited and said that India worshipped the cow while other countries fed and maintained their cattle and developed them for the social and economic betterment of the people. He

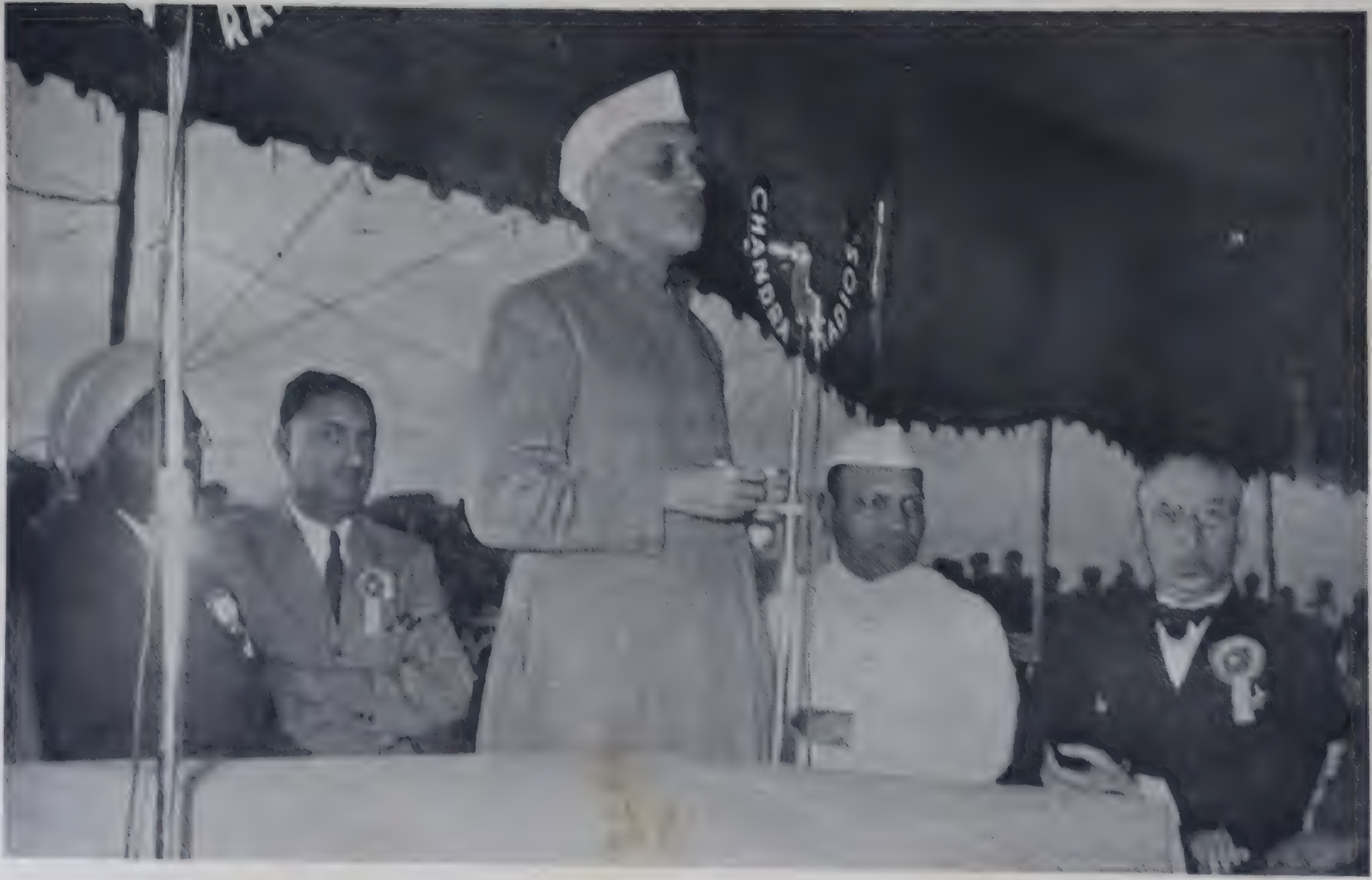

CHANDRA RADIOS

FIG. 1. Pandit Jawaharlal Nehru, Prime Minister of India, addressing the gathering

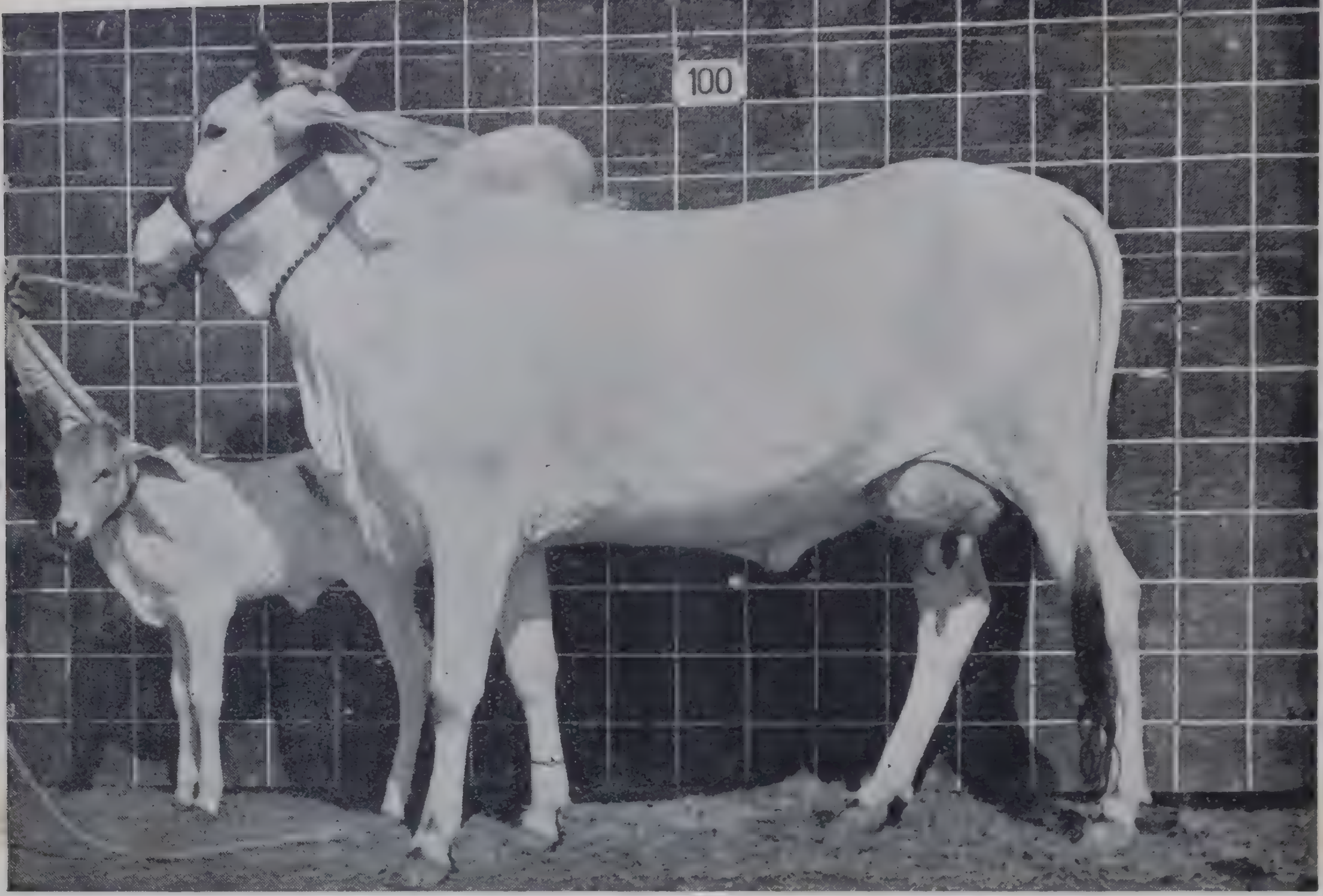
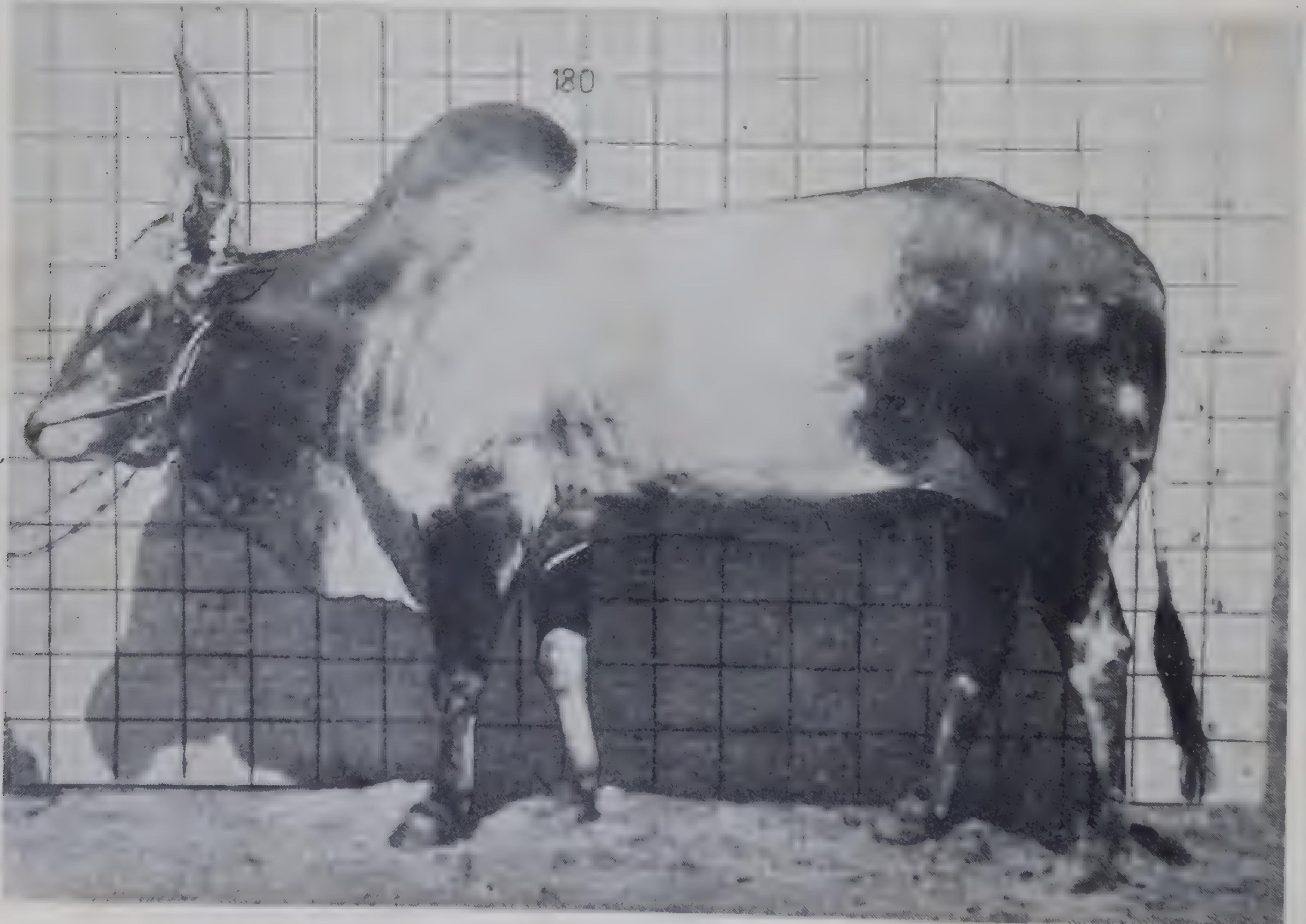


FIG. 2. (above). Hariana cow belonging to Krishna of Ranikhera, won Scindia cup and Marquess of Linlithgow cup for the best cow and the best animal in the show.

FIG. 3. (below). Kangayam bull won the Hyderabad cup for the best bull in the show. This belongs to the Livestock Research Station, Hosur Cattle Farm.



remarked incisively that it appeared to him that the best way of destroying a thing was to worship it.

Sixty trophies of the approximate value of Rs. 60,000 and cash prizes amounting to Rs. 6,250 were distributed. The most coveted prize of the Show, that for the best animal exhibited, was won by a Hariana cow owned by Choudry Krishna of Rani Khera. The same cow annexed another prize as the best cow in the Show. The Kangayam bull exhibited by Livestock Research Station, Hosur, owned by the Madras Government won the prize for the best bull, while H. H. Maharaj Pratap Singhji of Bhaini Sahib won two prizes allotted for the best buffalo cow and the best buffalo bull of the Show. The first prize in the milking competition was secured by a Hissar cow of the Delhi Pinjrapole which yielded 30 lb. and 12 oz. of milk in 24 hours. The second prize was won by a Sindhi cow of the Indian Dairy Research Institute which yielded 28 lb. and 12 oz. during 24 hours.

There were seven propaganda stalls at the Show conducted by various organizations, e.g. The Indian Council of Agricultural Research, Indian Agricultural Research Institute, Agricultural Marketing Department, Indian Dairy Research Institute, Rural Reconstruction Department of the East Punjab, Imperial Chemical Industries and Poultry Section of Delhi Province. All these stalls showed interesting exhibits of high educative and propaganda value, and some of them held demonstrations in addition.

The Students Judging Contest was conducted as usual at the time of the Cattle Show in order to train students in the judging of cattle. Six teams of students—one from the Allahabad Agricultural Institute, one from the Indian Veterinary Research Institute, two from the Indian Dairy Research Institute, one from the Indian Agricultural Research Institute and one from Kanpur Agricultural College—participated in the contest. The first prize was won by the Allahabad Agricultural Institute and the second by the Indian Agricultural Research Institute.

The auction sale of pedigree cattle which was held on the Show-ground on 24 February was not as great a success as it used to be. The number of animals offered for auction was very small and the quality also was not of the usual high order. This was at least in part due to the cutting off of the important breeds of Sahiwal, Sindhi and Tharparkar in Pakistan. The highest prize at the auction was obtained by Hariana cow belonging to a breeder of Rohtak.

The notable feature of this year's Show was the number of conferences held on the Show-ground. The atmosphere of the Show-ground was most suitable for these conferences which related to the various aspects of development of cattle. The pride of place in these conferences goes to the meeting of the Cattle Preservation Committee appointed by the Government of India in order to consider ways and means of regulating cattle slaughter, preserving India's cattle wealth and of promoting its development. This Committee met under the Chairmanship of Sir Datar Singh, Vice-Chairman of the Indian Council of Agricultural Research. Next in importance is the Breeders' Conference, which was called during the Show Week. It was opened by Sir Datar Singh and was presided over by R.B. P. N. Nanda, Animal Husbandry Commissioner with the Government of India. A number of breeders who came to Delhi to attend the Cattle Show, took part in this Conference in addition to the number of officials from all over India. Another meeting of importance was that of the newly set up Dairy Science Association of India. There was also a meeting of the Genetical Sub-Committee of the Ministry of Agriculture. As has been rightly said, it is not the assemblage of the cattle at the Show that is of importance, but the opportunity which the Show presents for the various persons engaged in cattle industry to meet, discuss and exchange their ideas. This Conference fulfilled this function with remarkable success.

As in previous years, the All-India Show in Delhi was a very great social event in the Indian capital. People from the different strata of society visited the Show and evinced interest in the value and variety of India's cattle wealth. A panoramic picture of India's cattle wealth was effectively presented on the last day of the Show when the prize-winners, which were representative specimens of the different breeds, were marched passed in front of the gathering assembled at the prize-distribution ceremony. Among the notable visitors to the Show, were the Hon'ble the Prime Minister, Pandit Jawaharlal Nehru, Shri Jairamdas Daulatram, Babu Satish Chandra Das Gupta, Mr. B. R. Sen, Secretary, Ministry of Agriculture, Members of the Constituent Assembly, and Sh. Mohd. Abdullah, Prime Minister of Kashmir.

What the Scientists are doing

KEEPING QUALITY OF *GHEE*

GHEE samples prepared from the milk of different breeds of animals maintained at the Indian Dairy Research Institute Farm, Bangalore and stored at 37°C. were found to have good keeping quality. After one year's storage the acidity was below 0·80 per cent oleic acid. As judged by the peroxide values (5 and below) the average keeping quality was between 9 and 10 months. *Ghee* prepared by heating up to 115°C. or by decantation process at 60°C. did not show any difference in the keeping quality.

Genuine *ghee* samples prepared under supervision were also collected from different farms in India and stored in the same manner as farm-produced samples. In most of the samples the acidity was below 1 per cent oleic acid after one year's storage. The keeping quality of *ghee* as judged by the development of peroxide value varied widely from centre to centre. The maximum average found was eight months for samples obtained from Hosur, and seven months for samples collected at Delhi.

To study the effect of feeds on the development of acidity in *ghee* the following were fed to cows and buffaloes in liberal quantities : tender grass, neem, tamarind and mango leaves, groundnut cake and sesame cake. Both cakes were also fed after storing for three months. These feeds were not found to influence the acidity development in any way. After storage for nearly a year a large majority of the samples had acidity below 0·80 per cent oleic.

From these results it is concluded that proper method of preparing and storing *ghee* are more important to ensure good quality in *ghee* than such factors as feed or breed of animals. (I.D.R.I.)

In twenty days, paddy flowers,
And in thirty bunch appears.

—*Agricultural aphorism from Bengal.*

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. We are interested in the manufacture of citrus fruit squashes. Could you kindly furnish the names and addresses of the firms who can supply the following machines?

(1) Orange and lemon halving machine.
(2) Juice extractors power-driven or hand-worked.
(3) Orange and lemon scooping machine.
(4) Fruit pulp screening machine. (R.N.C.)

A. The machines at (1) to (3) above are available from the following firms.

(a) Brierley W. Colliery & Hartley Ltd., Boroworks, Bridge Field Street, Rochdale, England.

(b) Kellie Robert & Son, Ltd., Dundee Foundry, Dundee, England.

(c) Aluminium Plant Vessel Company, Ltd., Wandsworth, London S.W. 18.

(d) Garlic & Company, Engineers and Iron Founders, Jacobs Circle, Bombay.

(e) Indian Aluminium Plant Vessel Co., Ltd., P.O. Box No. 2492, Calcutta.

(f) Gladwyn & Company, Powvalla Buildings, 251, Hornby Road, Bombay.

Hand-worked juice extractor (wheel type) can be had from :

(a) E.M. Allcock Ltd., 18 British Indian Street, Calcutta.

(b) Gardners Juices (India), 3 Haily Road, P.B. 299, New Delhi.

Power-driven juice extractor (Sunbeam automatic mix master) is available from Chicago Flexible Shaft Company, Chicago, Illinois. (I.I.F.T.)

THE yield is very heavy when sun hemp is sown thickly, *jowar* at a distance of frogs hopping and *bajra* at paces length.

—Agricultural aphorism from the United Provinces.

DEVELOPMENT OF VETERINARY DEPARTMENT, ASSAM

V. R. GOPALAKRISHNAN

THE Civil Veterinary Department, Assam, concerns itself mainly with the prevention and control of contagious diseases among animals by inoculation and vaccination and also with the treatment and cure of non-contagious diseases in the rural and urban areas. Among the contagious diseases, rinderpest ranks high, causing mortality of about 60 per cent of cattle population. For the control of the disease an adequate and regular supply of goat-tissue-vaccine and provision of sufficient number of technical staff for vaccination in the field, are essential. Hence two schemes were prepared by the Director of Veterinary Department, Assam, one for the establishment of a Veterinary Vaccine Depot at Gauhati and the other for a Veterinary College in Assam. The former has been sanctioned as a post-war development scheme and the latter is still under consideration of the Provincial Government.

Veterinary Vaccine Depot

It has been the practice all along to obtain goat-tissue-vaccine for use in Assam, from the Veterinary Vaccine Section, Bengal Veterinary Research Institute, Belgachia, Calcutta. The necessity for local production and supply of vaccine was, however, felt for some years past. During the war period, the supply of vaccine from Calcutta to the field staff was not regular. There was much delay in transport with the result that the vaccine was received in an unserviceable condition. Therefore in cases of urgent outbreaks, special messenger had to be sent to fetch vaccine from Calcutta. The same situation, more or less, persisted during the period of communal troubles in Calcutta. In fact, special arrangement had to be made with the Principal, Bihar Veterinary College, Patna, and the Director of Veterinary Services, Orissa, Cuttack, for supply of vaccine to meet the urgent needs of Assam.

To avoid all these difficulties, a scheme for the setting up of a Vaccine Depot was under the consideration of the Government of Assam. Recently the establishment of a Vaccine Depot at Gauhati has been sanctioned at a cost of a little over a lac of rupees and the work has already started. It is contemplated that the manufacture of vaccine will be undertaken after preliminary tests have been made and then the regular supply to the field workers will be arranged. With the working of the scheme in 1948-49, it is expected that the control of rinderpest would be more prompt and effective than hitherto.

Veterinary College

At present there is a paucity of qualified veterinary graduates who are natives of the province. The present system of deputing candidates recruited in Assam for training in the colleges of other provinces has got its obvious difficulties. Besides, there is an urgent need of technical staff, for the expansion and development of departmental activities. The control of rinderpest is a case in point. Other schemes for development are still pending. In view of all these considerations, necessity was felt to start a Veterinary College in Assam as early as possible. A scheme to this effect is now under active consideration of the Provincial Government.

In the meanwhile, provision has been made by the Government to train 100 Field Assistants

RAO SAHIB V. R. GOPALAKRISHNAN, is Veterinary Investigation Officer, Assam, Gauhati.

immediately. They will undergo a course of training for six months in elementary veterinary science including practical training in inoculation, castration and treatment of simple cases. The Field Assistants will be mostly utilized for vaccination against rinderpest under the general supervision of the Veterinary Assistant Surgeon.

SUGAR AND SUGARCANE PRODUCTION IN INDIA*

WHILE welcoming you to this Annual General and the Ninth Meeting of the Indian Central Sugarcane Committee, I cannot but refer you with great sorrow to the tragic atmosphere that overcasts the Metropolis of the Indian Dominion at the present moment due to the cruel and dastardly assassination of the Father of the Nation, Mahatma Gandhi. Our heads hang down in shame that a crime of this dastardly nature should be perpetrated by one of our own youths, who appears to have been led away by false ideas and rank communalism to commit this treacherous act. In his death, however, Gandhiji has become more powerful than during his life-time, as is evident from the glowing and world-wide tributes and homages that are being paid to him. He is now being recognized to be as great a Saint and leader, as Gautama Buddha or Jesus Christ. Like them, he has been our saviour and universal leader. It is regrettable that when his presence was most essential to guide us through the present trouble-ridden times, he has unfortunately been snatched away from us. Though he has passed away from this physical world, his life and teachings have become immortal and we sincerely pray that his great spirit will continue to guide and inspire us in the service of our Motherland for which he lived and died. His loss is a stupendous one and the vacuum thus created in the political and social life of the country can hardly ever be filled up. We all mourn this great loss and pray that the Almighty may give us wisdom and strength to follow the foot-prints of our beloved leader. Our sole consolation is that the whole world mourns with us. Personally, I have lost a very sincere friend, philosopher and guide to whom I invariably looked up for valuable advice and guidance.

I am sure that the members of this Committee would like to pay their respectful homage to his immortal memory by standing silently for one minute and praying fervently that his soul may rest in peace. Perhaps you would also like to record your profound regret at this dastardly act and to express your sympathies and condolences to the bereaved family. If you approve, we may pass the following resolution:

'The Indian Central Sugarcane Committee at its Annual General and the Ninth Meeting held on 26 February, 1948, mourns the tragic and unexpected death of Mahatma Gandhi, prays for eternal peace to his departed soul and places on record its sense of profound sorrow and shame at his treacherous assassination. The Committee also expresses its deepest sympathies and sincerest condolences to the bereaved family'.

As I pointed out to you in the last meeting, India has passed through momentous times during the financial year which is now closing. The partition of India has also affected the sugar industry to a certain extent; it will necessitate our laying down fresh targets of sugarcane and sugar production in the Dominion of India. Based on the figures of 1945-46, we see that 8,25,921 tons or 87·42 per cent of sugar was produced in the territory, now under the Dominion of India, 95,600 tons or 10·12 per cent of sugar was produced in the Indian States acceding to the former, whereas, only 23,279 tons or 2·46 per cent of sugar was produced in the area now under the Dominion of Pakistan. This reduction is not significant, but if the Pakistan Government ceases to consume Indian sugar and begins to import foreign sugar, some other venues of disposal of our own surplus will ultimately have to be found. We have just heard from the Government of India that the Partition Council has decided in its meeting held on 1 December, 1947, that the assets and liabilities of the Indian Central Sugarcane Committee would not be taken into account for division and financial adjustments between the Dominions of India and Pakistan. This indeed is wholesome news for this Committee.

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* Address delivered by Sardar Bahadur Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research and President of the Indian Central Sugarcane Committee at the Ninth and Annual General Meeting of the Indian Central Sugarcane Committee on 26 February 1948

As you know, the problems facing the sugar industry are immense and are to be reconsidered by those concerned, in the light of the present day circumstances, as the existing plans for production and development were prepared much before partition was effected. We are faced with a continuous spell of bad seasons, lack of adequate supplies of cane and lack of wagons and other transport facilities. To place the sugar industry on a sound footing, early steps have to be taken to improve our lot. You have sanctioned the 5-year schemes of sugarcane development for initiation in the main sugarcane tracts and financed from the special grant of Rs. 75 lakhs. As soon as the formal sanction of the Government of India is received your recommendations regarding these schemes will be brought into effect. This sanction is expected in the course of the next few days.

On the recommendation of the Indian Tariff Board, the Government of India have agreed to increase its annual contribution to the Committee four-fold, until further orders. We expect to secure in this way a grant of about Rs. 50 lakhs in place of the expected Rs. 11·75 or 12·50 lakhs and will thus be in a position to take up fresh schemes of research and new projects of translating the results of research into actual practice in agriculture, technological, economical and other aspects of sugarcane development. The intimacy of relationship between research on the one side and progress and prosperity of the industry on the other is well-recognized and it appears to be our main duty, in this Committee, to initiate and develop fundamental as well as applied research in a way that they provide a sound basis for the development of the sugar industry in India. Every effort will be needed to increase sugar production by a steady process of all-round expansion, viz. by the increase of cane acreage, by improving the quality and quantity of cane produced, by evolving disease-resistant and high yielding varieties of cane with different periods of maturity and harvesting, and to increase the normal length of the crushing season to 110 to 130 days, by providing better supplies of cane to the factories, by providing remunerative cane prices to the growers, by providing adequate quantities of manures and fertilizers, as well as, of irrigation water, etc. The production of the maximum quantum of quality cane, with a high sucrose content, therefore, appears to be the main factor for maximizing the production of sugar and lowering its cost of production. The cost of the raw material itself forms more than 60 per cent of the total cost of manufacture of sugar and hence the future advancement of the industry and economy in the cost of production of sugar must necessarily depend upon the proper development of the cane itself. A great deal of thought, planning and research, both from the agronomic as well as the breeding points of view, appear to be essential factors for securing larger yields of cane per acre. The importance of resistance to and control of serious diseases and pests cannot be over-emphasized. We are glad to record that the manufacturing efficiency of modern sugar factories in India is improving steadily and with the renovation of old and installation of new machinery as well as the utilization of more economic units it is hoped that this efficiency will increase still further. The question of economizing fuel in sugar factories needs immediate attention and some staff is being recruited at once to initiate the Fuel Economy Survey Scheme with immediate effect.

The utilization of the by-products of the industry, such as molasses, bagasse, press-mud and the installation of auxiliary industries for the production of power alcohol, rectified spirit, sugarcandy, confectionery, food-yeasts are matters which also deserve greater attention than has been paid to them so far.

We all realize that the development of the sugar industry in India has been possible mainly due to the grant of fiscal protection to it. For the present, this protection has been extended up to the end of the current financial year, but it is hoped that the Government of India will again review the position and extend this protection for a longer period to encourage and promote rapid industrialization to its fullest extent.

During the past two or three years, the production of factory sugar is on the decline, due to the reduction in sugar acreage, brought about by the diversion of some land from cane cultivation for the 'grow more food' campaign, better prices of other commodities and certain other difficulties, whereby the full crush of the season has not been possible. Steps to increase sugar production are, therefore, urgently needed.

In our last meeting held in November, 1947, we had discussed the question of remunerative prices of cane that should be paid to the growers and the recommendations of our *ad hoc* Sub-Committee appointed for this purpose, were forwarded to the Government of India for consideration. Higher prices of cane were sanctioned this year by the Government in consultation with the Provincial Governments, but with the decontrol of sugar and the unexpected lowering of *gur* prices, the lot of the grower again appears to be at stake.

During the year, the Bhadruk Military Grass Farm, consisting of about 553 acres of land and some buildings, has been taken over from the Ministry of Defence for establishing the Institute of Sugar Technology and Sugarcane Research at Lucknow. Tentative plans and estimates for this Institute have been prepared and have been examined by the *ad hoc* Advisory Sub-Committee three days ago, and its recommendations will be put up for your consideration today. In the meantime, the Bhadruk Farm has been handed over temporarily to the Government of the United Provinces who were anxious to utilize this place for their 'grow more food' campaign and Dairy Development Scheme until such time as the Committee required this Farm for building and/or farming purposes. If the Government of India accept the recommendations made by you in your last meeting, we may take over the complete charge of the Sugarcane Breeding Station at Coimbatore and its Sub-Stations. If this is accomplished, it is visualized that all aspects of sugarcane breeding, sugarcane agronomy and sugar technology would be thoroughly investigated under one central organization, the Indian Central Sugarcane Committee.

When you consider the budget estimates of the Indian Central Sugarcane Committee for 1948-49, you will notice that the total expenditure on the present commitments is estimated at Rs. 13,27,400 as against Rs. 11,88,100 in 1947-48. The details are shown fully in the Statements and Schedules submitted under Subject No. 2 of the agenda.

In addition to the budgeted figures certain additions might have to be made if the expansion of the office staff of the Committee and certain other items provided in the Secretary's notes are approved by you today. Similarly, if you agree to subsidize the standing development schemes in the provinces on the *pro-rata* basis of white sugar production, as adopted last year, a further sum of Rs. 1,75,100 will be spent in 1947-48. If the Government of India continues to contribute its grant to the Committee on the increased basis of four annas per cwt. of sugar produced as has been recommended by the Indian Tariff Board, the year 1948-49 is expected to close with a balance of about Rs. 95,64,700 *minus* about Rs. 2 lakhs, but the exact position is not yet known until we receive a definite communication to this effect from the Government of India. Necessary provision will also have to be made for the establishment of the new Institute at Lucknow and for purchasing the necessary material, implements and machinery for it. A sum of Rs. 50 lakhs for the establishment of the new Institute has, undoubtedly, been earmarked by the Government of India from the Temporary Sugar Excise Fund, but this will have to be supplemented further from the annual savings in our budget. A sum of about Rs. 12 lakhs will be required for payment to the Defence Ministry for the land, fencing and buildings alone. The expenditure to be incurred for the five-year development schemes from the special grant of Rs. 75 lakhs from the Government of India will be budgeted for as and when received.

In order to utilize the expected balance in the best interests of the industry, you have to consider whether any other schemes should be invited, from those concerned, for initiating economic research, inquiries and recommendations relating to banking and transport facilities and transport routes, for marketing facilities, improvement of crop forecasting and statistics, publication of a journal, initiation of other research or development schemes and taking up of other important items included amongst the functions of the Committee originally given in the Memorandum of Association of this Committee, but not yet implemented for want of funds.

A number of new schemes are for your consideration at this meeting, but I do not propose to go into their details at this stage, as, I am sure, you will give them due consideration as they come up in the agenda today.

One-third of the members of the Committee are to retire this year in rotation and the retiring members could be re-appointed if their respective constituencies re-nominate them. The various Sub-Committees will have to be re-appointed for the next financial year and a Vice-President has to be elected. During the year under review, the General Body has met three times and I am grateful to all the members for the cooperation and help they have invariably given to me throughout the year. It is my pleasant duty to express my gratitude to Sir Shankar Lall who has very kindly helped me throughout the period he has been ably discharging the duties of the Vice-President and also to the Chairman and members of the various Sub-Committees and *ad hoc* Committees. The satisfactory manner in which the Secretary and his staff at the Headquarters and the Director and his staff at the Indian Institute of Sugar Technology at Kanpur have discharged their respective duties is commendable and deserves mention.

I thank you once again, Gentlemen, for your continuous help and cooperation and with your permission I will now take up the agenda of the meeting.

BARODA

T. V. MULYE

MODERN fruit plantations are maintained at the major agricultural experimental stations where education is imparted to the students in methods of gardening and fruit preservation. During the year 1946-47, fifty students received training.

Fruit research

Research work is concentrated at the Fruit Research Station, Gandevi in Navsari District. Here largescale propagational and manurial experiments are carried out. Observation shows that in mango grafts, the union of scion and root-stock is even and stronger when the tying is done with banana fibre and continuous and closer circles of twine, than in the gappy local method which uses no banana fibre.

Pine-apple: Three varieties were tried and indications are that Giant Kew and Mauritious varieties are flourishing in the local conditions and are becoming popular. Dry cultivation of pine-apple in Gandevi area seems to be promising.

Grape fruit: Marsh, because of its adaptability to the wide range of soil and climatic factor, has gained popularity. Another advantage of this variety is that trees were found to be profitable when allowed to fruit naturally.

Development: Two commercial fruit nurseries have been established with model plantations at Dhari and Kodinar (Kathiawar), where over 10,000 fruit plants have been sold out. In order to encourage fruit plantations, the Government of Baroda gives a free grant of the waste land and a bounty of Rs. 30 per acre so that new plantations could be raised. During the year Rs. 1,120 were given out.

Cigarette tobacco

The activities for introducing Virginia tobacco started from the year 1933. The object was to see if this variety could replace the country crop with economic advantage to the grower. The initial trials at Baroda farm were encouraging and the activity was extended to moffusil centres at Bajwa, Bandhani and Ramol. This proved a great success and the local growers got interested with the work and took over the entire development in their own hands.

The activity has since then been extended to Vijapur centre (Mehsana District), where an experimental barn in collaboration with the Indian Central Tobacco Committee has been set up. The preliminary tests show that the crop responds well to the soil and climatic conditions and the flue-cured product was appreciated by the people round about the centre and also by the Indian Central Tobacco Committee.

T. V. MULYE is Technical Assistant to the Commissioner of Agriculture, Baroda.

Across the Borders

PARASITIC ANIMALS AND THE WORLD'S FOOD

By G. LAPAGE

THERE is no need at the present moment to stress the difficulties which impede the supply of an adequate diet to the nations of the world. The conservation and increase of supplies of food, their distribution, the regulation of their consumption by the various peoples, the prevention of waste, and a number of other problems, are engaging the urgent attention of experts all over the world. Much has been written about these problems, but comparatively little—or, some would say, all too little—is told to the public about the losses inflicted upon our food supplies by living things which prey upon them in one way or another, whether these be animals which consume them as food, or bacteria, viruses, or parasitic animals and plants which cause disease. These losses are suffered, first, by our crops and, second, by our domesticated animals, which provide us with meat, milk, eggs, and other products.

It is always difficult to assess this damage with accuracy. Probably we shall never know the precise extent of the injury done to crops by living things which either directly consume them or produce disease in them. Estimates of the damage done to domesticated animals by bacteria, viruses, and parasitic animals have, however, been made. Although this article is concerned chiefly with the losses inflicted upon our food supplies by parasitic animals only, it is helpful at the outset to gain some idea of the total losses inflicted by all kinds of disease.

Loss of food supplies

Two estimates, one of the total losses incurred in Britain and the other of those in the United States, will give us in financial terms a measure of the order of the injury inflicted by the combined activities of bacteria, viruses, and parasitic animals. The Second Report of the Committee on Veterinary Education in Great Britain[1] published in 1944, states that the annual loss in England and Wales, due to diseases of farm livestock alone, is 10 per cent of the output of the meat, poultry, and dairy industries, and represents a loss of nineteen million pounds a year. The National Veterinary Medical Association of Great Britain and Ireland later showed that this estimate was too low, and added evidence that four of the major diseases of cattle alone caused an annual loss of twenty million pounds, of which twelve millions were ascribed to the loss of milk and the remainder to loss of stock. With these statements we may compare the estimate of the United States Bureau of Animal Industry[2], issued in 1942, that the total loss on domesticated animals in the United States through all the diseases listed in the estimate was 418 million dollars a year. W. A. Hagan, a distinguished American veterinary expert, has expressed the opinion[3] that this figure is far too low and should be increased to at least 1,000 million dollars.

Hagan and others have further pointed out that diseases of farm animals affect our food supplies, not only by killing the animals but by retarding their growth and reducing their production of milk and eggs. They may also injure their breeding capacity and render them liable to further diseases. Sick animals require special care and feeding and may cause considerable loss of food materials which might otherwise be converted into meat, milk and eggs, or diverted to human use. This wastage is by no means negligible. Experiments in the United States, for instance, have shown that whereas 3·1 lb. of feed will produce in seven weeks a weight increase of 1 lb. in chickens protected from parasites, 4·5 lb. of feed are required to produce a weight increase of 1 lb. in infested chickens. Experiments on sheep and cattle in Britain, the United States, and elsewhere show that the same general conclusion applies to these animals also. There can be no doubt that persistent unthriftiness, differentiated from actual disease or death, is one of the major causes of the serious loss of food supplies indicated by the figures quoted above. And these, be it noted, are figures of the losses inflicted upon food supplies derived from domesticated animals only. If the loss inflicted upon our crops could be added to them, the total would indeed be startling.

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[1] Second Report of the Committee on Veterinary Education in Great Britain, 1944 (H. M. Stat. Office)

[2] *Yearbook of the U. S. Dept. of Agric.*, 1942 (U. S. Govt. Printing Office)

[3] Hagan, W. A., *et al. Ann. New York Acad. Sci.*, 1947, **48**, 351

Losses due to other organisms

When we inquire into the relative degrees of damage done by different diseases of farm stock it becomes very difficult, if not impossible, to assess accurately the relative importance of diseases caused by bacteria and viruses on the one hand, and those caused by parasitic animals on the other. In one country the former may be the more important, in another country the latter; and unpredictable factors, such as local epidemics, may upset the normal state of things. The estimate mentioned above[2], ascribed an annual loss of 290 million dollars to the various parasitic animals included in that estimate, a figure which is 69 per cent of the total loss caused by all the diseases considered. In some other countries the relative losses inflicted by these two classes of injurious organisms might well be reversed, but in all parts of the world, and especially in the warmer countries, parasitic animals are responsible for a great deal of the damage. It is, in fact, never easy to assess the relative importance of the bacteria and viruses and the parasitic animals. One reason for this difficulty is that parasitic animals may seriously affect the health of domesticated stock without causing actual disease; the health of the stock may, however, be reduced by them to such an extent that their resistance to diseases caused by bacteria and viruses is lowered, perhaps fatally. Conversely, bacteria and viruses may affect the vitality of animals so seriously that they contract heavy infestations with various other parasites which still further damage their health.

Let us now transfer our attention more particularly to the various kinds of parasitic animals which menace the world's food supplies. Briefly we may say that they belong to four of the main divisions into which the zoologist classifies the animal kingdom. These divisions are:

1. The Protozoa, single-celled animals of which an example is the malarial parasite of man.
2. The Flukes (Trematoda) and Tapeworms (Cestoda).
3. The Roundworms (Nematoda), a group which includes (a) the eelworms and their relatives, which attack potato, sugar beet, wheat, oats, barley, rye, and other edible crops as well as many plants of horticultural value, and (b) several species injurious to farm livestock.
4. The insects, ticks, and mites, and some of their relatives.

To these in localized areas, and especially in the warmer countries, we may add some kinds of leeches and the few species of blood-sucking bats.

Some estimates of the losses inflicted by particular species of these parasitic animals will reveal the extent of their threat to our food supplies and the saving of essential foods which might result if their attacks could be effectively controlled.

Protozoa

The annual losses caused by various species of protozoa in the United States have been estimated at ten million dollars[2], and half of these losses have been ascribed to the disease of poultry called coccidiosis. This disease is caused by protozoa belonging to a group called the coccidia, one species of which (*Eimeria tenella*) may be so harmful that it has been estimated[4] to kill 12 to 20 per cent of all the chicks hatched in the United States. Other species of coccidia attack other domesticated birds and also cattle and sheep, being especially harmful to calves and lambs. Among the protozoa are also the trypanosomes, some species of which cause the diseases called nagana of cattle and surra and dourine of horses; the organisms which cause histomoniasis of turkeys and trichomoniasis of cattle; the species of the genus *Babesia* which cause redwater fever and Texas fever of cattle; and the relatives of the genus *Babesia* which cause the deadly East Coast fever of cattle in Africa (theileriasis) and anaplasmosis. An estimate[2] of the losses due to anaplasmosis in the United States is $100,000 a year, and one severe outbreak of this disease in Kansas in 1944 caused a loss of $2,500,000 as a result of the deaths of the cattle affected[4]. This latter estimate is a good example of the great increase in the losses sustained which may occur when, for any local or other reason, a disease assumes epidemic proportions.

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[4] Report of the Administrator of Agric. Research (U.S. Dept. Agric., Agricultural Administration, 1944).

Flukes and tapeworms

The flukes and tapeworms are responsible for extensive losses of meat and other foods provided by animals, the liver fluke being especially harmful in this way. It attacks the livers of cattle and sheep and may either kill the animal or affect its health so severely that much meat and milk are lost. A statistical analysis[5] of the records of the slaughter of more than 73,000 cattle in England and Wales has shown that this parasite may cause an annual loss of liver substance costing, at retail prices, £200,000. To this must be added the loss of liver extracts for medicinal purposes and the high, but not easily assessed, reduction of meat and milk. There is little doubt also that the liver fluke may also cause appreciable deterioration of the capacity to produce calves and lambs.

In the United States the losses caused by the liver fluke are proportionately higher. During the eleven years between 1933 and 1943 the livers of 1,400,000 cattle and 60,500 calves were condemned because they were infected with liver fluke, and it was estimated[6] that 1,075,000 lb. of liver were lost annually during this period. The annual loss in live weight of cattle and calves was estimated at about 2,733,000 lb. which amounts to about 1,366,000 lb. dressed weight. The annual loss of food in terms of liver and beef was stated to be 1,220 tons. The milk secretion was lowered by 16 per cent by heavy infestations with liver fluke, and the breeding activities of the animals were also reduced. This estimate may be compared with the statement made by the United States Bureau of Animal Industry[2] that the annual loss caused by liver fluke and tapeworm in the United States amounted to five million dollars. It is known that in some areas of the United States 50 per cent of animals' livers have to be condemned because they are infested with liver fluke[7], and this figure may be at times equalled or even exceeded in slaughter-houses in some parts of Britain. We have to remember, of course, that liver fluke disease depends for its distribution upon certain species of aquatic snails, and that its incidence is therefore controlled to a considerable degree by the nature of the country and by climatic conditions. It is a disease especially of damp areas, and this is one of the reasons why it is most prevalent in Britain, in north-west England and North Wales. It is, however, also common in South Wales and south-west England, while the areas most free from it are the southern and south-eastern countries. In some parts of Eire its incidence would seem to be even higher than it is in England and Wales.

Roundworms

The group of roundworms includes some of the most damaging pests of food-producing animals, and hardly any country in the world escapes the serious losses which they can inflict. In this group also are the eelworms and their relatives, which do such extensive harm to many of man's esstenial crops. In Britain the full extent of the damage caused by these species is not yet known, but they certainly severely injure our crops of potato and sugar-beet in some areas. Other species of the roundworms parasitic upon plants attack wheat, oats, barley, rye, tomatoes, and other edible plants, and the horticulturists experience considerable losses caused by species which attack a great variety of flowering plants.

The roundworms parasitic in farm livestock belong to several species which attack various organs of the body, but probably the most harm is done by the species living in the food canal. Those in the food canals of sheep, cattle, and domesticated birds cause a form of gastroenteritis which is one of the most serious handicaps of the livestock farmer throughout the world. The National Veterinary Medical Association of Great Britain and Ireland has estimated[8] that the gastro-enteritis caused by these roundworms in sheep alone costs Britain some £348,000 a year, a sum which is about one-third of the total cost of the ten major diseases from which British sheep suffer. To this loss must be added the losses due to the similar disease in cattle and also that caused by other species of roundworms which attack cattle or sheep or both. Among the latter species are the nodular worm which render the intestines of sheep useless for the manufacture of catgut and other products, and the hookworms which suck blood.

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[5] Peters, B. G. and Clapham, P. A. *Jour. Helminthology*, 1942, **20**, 115.

[6] Olsen, O. W. *Liver Fluke Disease* (U.S. Dept. Agric., Bur. Animal Industry, 1944).

[7] *Proc. 46th Ann. Meeting U.S. Livestock Sanitary Assoc.*, 1942.

Many species of roundworms consume blood, but the hookworms remove especially large quantities of it. Anaemia is, therefore, one of the common symptoms of disease caused by the roundworms which live in the food canal. The nodular worms also unfavourably affect the condition of the animals in which they live, and it has been estimated[9] that they cause in the United States a loss of 45,000 tons of mutton annually, not to mention a further annual loss of 6 million dollars due to damage to the intestines used for the manufacture of catgut. Nodular worms may damage the livers of the animals in which they live, and thus add appreciably to the losses caused by the liver flukes.

Another roundworm (*Onchocerca gibsoni*), which is sometimes called the nodular worm of cattle because it causes the formation of nodules in the skin and underlying tissues of these animals, inflicts severe losses in Australia[10]. Beef carcases have to be mutilated by the excision of the nodules before they can be exported to Britain, and briskets may have to be removed. As many as 80 per cent of the cattle in central and north Australia, may be thus affected[11], so that the losses may be very great. They are all the more serious because this roundworm does not occur in Argentina, a country which is one of Australia's chief competitors in the beef export trade. In addition to the species just mentioned, other kinds of roundworm do appreciable damage in various parts of the world. There are, for instance, the giant kidney worm, which attacks the kidneys of pigs, the large roundworm which lives in the intestines of these animals, and other species which live in the intestines of poultry and other domesticated birds. An idea of the overall damage inflicted by roundworms as a whole may be gathered from the estimate[2] that they are responsible, in the United States, for a total loss of 110 million dollars every year.

Insects, ticks, mites

The large group of animals which includes the insects, ticks, mites, and their relatives may affect our food supplies in several ways. First, they may themselves consume human and animal foodstuffs. Examples of this kind of damage are so familiar that we need only mention the enormous damage inflicted by locusts, and the losses due to the many insect pests which attack our crops. Less well-known is a second type of damage caused by insects, ticks and mites which are temporarily or permanently parasitic on the exterior of the bodies of farm livestock. These species harm animals and birds in at least three ways: (1) they annoy and irritate to such a degree that the animals suffer from this cause alone; (2) their young (larval) phases may be parasitic in the internal tissues of the animals; and (3) they may transmit to the animals other kinds of parasites which cause serious diseases. Some species of them inflict more than one of these kinds of injury. The extent of the first-named kind of harm is not, perhaps, always realized. Animals and birds which are continually being bitten by blood-sucking external parasites such as mosquitoes, lice, and ticks not only lose blood and suffer from infected bites or sores produced by scratching, but are also restless and lack sufficient sleep. Consequently they do not feed normally and fail to thrive. Nor is this kind of injury inflicted only by biting and blood-sucking species. Some kinds of insects, such as the warble flies, whose larvae develop inside the bodies of cattle, do not bite their hosts, merely laying their eggs upon their hairs or skin, but the animals are thrown by their approach into a state of unrest. They may even stampede and rush wildly about, giving the impression that they are trying to avoid the flies; or they may take refuge in water and shady places, suggesting to the observer that they are aware that some species of warble flies lay their eggs only on the legs or lower parts of the body. The animals thus affected do not feed properly and therefore do not produce so much meat or milk. Horses may be affected in a similar way by horse bot flies. It is difficult to estimate the reduction of food supplies caused in these ways, but an idea of its extent may be gathered from one estimate[2] which places the damage done in the United States by the external parasites of poultry at 85 million dollars a year.

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[8] Report on the Diseases of Farm Livestock (National Vet. Med. Assoc. of Gt. Britain and Ireland Publication No. **6**, 1944).

[9] Report of the Secretary of Agriculture, U.S.A., 1942.

[10] Ross, I. C. *Jour. Sci. Ind. Res.*, Australia, 1927-8, **1**, 233

[11] Nevin, S. M. *Bull. U.S. Army Med. Dept.* No. **81**, 113-19.

The damage inflicted by the larval phases of insects and other arthropods upon the internal tissues of farm livestock into which they penetrate may be much more serious than that which is inflicted by external parasites. In this category we should include the mites which cause the various forms of scabies, because these mites live, not on the exterior of their hosts, but actually in the tissues of the skin. Here also we include the larvae of warble and bot flies just mentioned. The larvae of the former, after a period of life in the interior of the bodies of cattle, appear under the skin along the backbone, where their presence causes the formation of abscesses in the pus of which the larvae live. They cut holes in the skin in order to obtain oxygen from the air, thus doing considerable damage to the hides. In addition, the meat around the abscesses is rendered unfit for human consumption. The total damage caused is therefore considerable. The United States Bureau of Animal Industry[2] assesses its cost at 65 million dollars a year, and in other countries the harm done is proportionately high. The larvae of the screw-worm flies, and those of the blowflies which attack sheep and cause the formation of sores and abscesses in the skin, also do extensive harm. Similarly the larvae of the sheep nostril and nasal flies, which burrow into the nasal sinuses and may attack the brain itself, cause heavy losses in the form of poor condition or actual death. In the United States hornflies are serious cattle pests, and the buffalo fly is spreading in Australia, where it attacks cattle.

The third form of damage inflicted by bloodsucking insects, ticks, and mites, namely the harm caused by their introduction into farm livestock of other kinds of parasitic animals, can hardly be estimated. Examples of diseases transmitted to farm livestock have been given earlier in this article. Many species of ticks are especially harmful in this way, because some of the causes of disease transmitted by them are passed from one tick generation to another. If we could get rid of the ticks and also of the insects injurious to farm livestock the majority of which belong to the group of two-winged insects (deptera), we should be able to eradicate many of the most serious diseases of farm animals.

Throughout this article an attempt has been made to focus attention upon the parasitic animals rather than upon the bacteria and viruses which affect the food supplies of the world. If the food supplies of Britain or any other individual country had alone been considered, the picture would have differed in some details, because in some countries, and even in some areas of each country, different species of parasitic animals cause greater losses than they do elsewhere. Nowadays, however, it is the world picture of food supplies that matters most. Lack of space has prevented discussion of one important feature of it, namely the damage which may be inflicted upon foods after they have been gathered.

Prospects of control

At first sight the picture presented is not a cheerful one, but we may take comfort from the reflection that it is a picture of one aspect only of a many-sided complex, the full consideration of which would require a volume. It has not been possible, for instance, to discuss the important implications of the fact that the study of parasitic animals and their control is still so young a branch of science that the major advances in it have been made within the last fifty years or so, many of them during the last decade. Nor has it been possible to discuss the implications of the recent discoveries of such powerful antiparasitic weapons as Gammexane, D.D.T., the sulphonamide drugs, phennothiazine, hexachloroethane, and other substances, some of which promise to give us, when we have learnt how best to apply them, a much greater measure of parasitic control. Not less important and possibly in the long run more important, are effective improvements in our methods of managing farm livestock and crops, some of which have been specifically devised to combat the organisms which cause disease.

The contributions made by the study of animal and plant nutrition are proving to be specially important in this respect. These improvements are based upon biological studies of farm animals and crop plants and of the organisms which attack them, and are among the finest fruits of the modern cooperation between the veterinarian, the physician, the biologist, the biochemist, and the biophysicist.

There is little doubt that the coordination of scientific effort will eventually give us all the necessary control of the menaces to our food supplies indicated in this article. From its haunts in the wilds of Brazil a species of malaria-carrying mosquito was largely eliminated, and this amazing feat was recently repeated in Egypt. Tuberculosis of cattle, imported into the United States from Europe during the nineteenth century, has now been virtually extinguished in that country, and this has been done in spite of the fact that we know of no drug which will cure this disease of man and animals. Several factors have cooperated in the accomplishment of these tremendous achievements, but not the least of them have been hard work, the cooperation of men with one another, the will to succeed, and the necessary money to put into action the measures which scientific research has indicated. If the same degree of effort, the same willing international cooperation, and the same resources of money and knowledge are applied to the biological menaces to the world's food supplies, there is little doubt that, whatever else may happen to the food of the world, it will not in future suffer the enormous losses which now deplete it at its very sources.—Reproduced from *Endeavour*, January 1948.

2,4-D WEED KILLER

TESTS made with 2, 4-D weed killer show that annual weeds readily killed are common, ball, and tumbling mustards, stinkweed, ragweed and sunflowers. Less easily killed are pigweeds, Russian thistle, purslane and chickweeds. Resistant weeds are cockles, wild buckwheat and all annual grasses including wild oats. Dandelion is the lone perennial easily killed. Canada thistle, sow-thistle, leafy spurge and hoary cress can be killed to the ground with the usual application but roots remain viable and regrowth soon occurs.—*Dominion Department of Agriculture, Canada*, December 31, 1947.

CULTIVATION OF ARECANUTS

ARECANUT palm is essentially a cool climate plant grown in tracts where the rainfall is heavy and water supply abundant. Its original home is said to be the forests of Eastern Asia. *Supari*, *Pau*, *Okkalu* and *Adakai* are the various Indian names for the arecanut, while betelnut is its foreign name.

Production

The chief arecanut-growing areas in India and Pakistan are (1) the districts of Noakhali, Chittagong, Bakurgung, Khulna, Jessore and Midnapur in Bengal; (2) the districts of Shimoga, Kadur, Hassan, Mysore and Tamkur in Mysore; (3) South Canara, Malabar and Coimbatore in Madras; (4) Sylhet in Assam; (5) the districts of North Canara and Ratnagiri in Bombay; (6) Tailapalli, Trichur and Mukundapuram taluks in Cochin; (7) Travancore; and (8) some villages of Coorg. These places of production are arranged in the order of importance.

The three well-known foreign countries producing arecanuts are Strait Settlements, Ceylon and Burma. The acreage and the production of arecanuts in the various foreign countries are not available on record in India. In the absence of this information, it is not possible to say with any reasonable degree of accuracy what position India occupies in the world production of arecanuts.

The figures showing the acreage, production and value of arecanuts in India are based on estimates. The pre-war estimate in 1937-38 showed that the area under arecanut in India was 4,96,860 acres of which about 2,14,060 acres were in East Bengal and 2,760 acres in West Bengal, 25,260 acres in Assam, and 2,82,000 acres in the gardens of the arecanut-producing areas of the South India. The total annual production of arecanuts in India, as estimated in 1937-38, was about 90 lakhs of maunds valued at about Rs. 5¼ crores; while the total annual consumption of arecanuts in India was over 1 crore of maunds valued at Rs. 8½ crores. The present value would be over 40 crores of rupees.

While India had imported 59,13,060 maunds of arecanuts from foreign countries in 1937-38, she had not exported any quantity outside.

Planting, manuring and harvesting

It is said that in the forests of Strait Settlement areas, the arecanut palms are a mushroom growth under natural conditions as the date palms grow in our forests in India. In India, the arecanut palms are invariably grown under deliberate and systematic, though traditional, cultivational methods.

The best-kept garden begins to yield only after 12 to 15 years. After this period there is another planting in the interstice, and still another after 30 years. The whole garden with its 800 to 1,200 trees per acre, begins to yield only after 30 years.

The manuring of an arecanut garden is done once in three years. For this purpose, the garden is divided into convenient plots and each is taken up in rotation, so that the manuring of the whole garden is completed by the end of the third year.

The harvesting of the arecanuts begin in the month of October at the close of the south-west monsoon and ends in January of the coming year. The harvesting consists in the selection and the plucking of the bunches of the required ripeness in the nuts. The selection of the proper bunches and their picking is a skilful and a very hazardous job, particularly in the plantations of Mysore, where the cooly on work will climb up a strong and well-formed tree and rests on the top of it drawing the surrounding trees, plucks the bunches therefrom and jumps on from tree to tree repeating the operations in the same way. There will be four pluckings in the season.

The bunches plucked will be collected in a heap and left in the open yard for two or three days to permit a slight hardening of the kernel and its separation from the outer covering. In North and South Canara, the nuts will be dried in the sun for quite a number of days before the outer husk is peeled off.

With the peeling of the nuts and the separation of the outer covering, the arecanuts are ready for the market in all the producing areas of arecanuts in India, excepting Mysore and part of South Malabar, where the nuts, peeled off of the outer covering, undergo further processes of slicing and colouring.

In gardens which contain early maturing types of arecanuts, the first harvest comes off before the close of the monsoon; and the nuts harvested during the period, for want of sun, are dried under hot smoke from the fire below a platform. Nuts treated this way are darker in colour and have a smoky flavour, and consequently fetch low price when put on the market.

Marketing

The varieties and their distribution in the markets may be classified under five broad headings given in Table I.

TABLE I

Varieties of arecanuts and their distribution in the markets

Varieties	*Where produced*	*Where consumed*
(1) Unboiled whole nuts	(1) North Canara and Ratnagiri Districts in Bombay (2) South Canara and North Malabar in Madras	Bombay City and the whole of the Bombay Presidency excepting the south-west regions of Bombay, Central Provinces, Sind, Central Agency Tracts, States of Western India and Rajputana.
	(3) Bengal and Assam	Bengal, Assam, Bihar, Orissa, Central and United Provinces, Punjab, Rajputana States, Kashmir and Bombay City.
(2) Boiled whole nuts	(1) North Canara (90 per cent, (2) Mysore (10 per cent)	Bombay City, Poona onwards to Raichur including Dhond, Hotgi, Kurudwadi, Pandrapur, Bijapur, Sholapur, Hyderabad and Gadag.
(3) Boiled double-sliced nuts	(1) Mysore (80 per cent) (2) South Malabar (20 per cent	80 per cent in Madras City and the subsidiary markets of Madras in Vellore, extending down to Coimbatore, Guntur, Bezwada, Nellore, Ongole and up to Berhampur in the north, Bellary and the whole of the Ceded Districts, part of Hyderabad and a few places in Bombay Presidency.
(4) Boiled sliced nuts (Palghat Churu)	(1) South Malabar	Whole of Madras Presidency and Mysore State.
(5) Unboiled chipped nuts	(1) Travancore (2) Cochin (3) Coimbatore	Consumed locally in the areas of the Madras Presidency in the south of Coimbatore. Small export to Madras City.

Note: The unboiled whole nuts and chipped nuts imported from the Strait Settlements, Java, Hongkong, Ceylon and Burma are distributed in the whole of India through the principal harbour cities of Madras, Bombay and Calcutta. These imported varieties are cheaper in price and are generally consumed by the lower middle classes and the poor.

The markets of arecanuts in the distributive channel may be broadly classified into three: (1) Local markets, i.e. markets in the vicinity of small growers of arecanuts where local *sahucars* and merchants operate in financing the growers before the crops are harvested and buy outright of their produce after the harvest. They assemble quantities of arecanuts and consign them to the commission houses (*mundies*) of the central markets. The principal local markets, for example, in Mysore are: Tirthabahalli, Koppa, Sringeri, Narasimharajapur, Sagar, Tarikere, Birur, Gubbi, Hassan, Periyapatna, Mysore and Bangalore. (2) Central markets are located in the railway centres where facilities for storage, financing, grading and transporting are created by commission merchants. These commission agents-cum-merchants store the arecanuts in their warehouses and advance loans up to a limit of 80 per cent to 100 per cent on the estimated value of arecanuts received for sale on trust from the local merchants and the larger growers, at rates of interest ranging from 6 to 9 per cent. They charge a commission of 4 annas per maund of arecanuts sold through them. To the merchants of the buying centres they render services in grading, transporting and sometimes financing in the course of the trade. Generally, they transact through another middleman called broker who is the resident agent in the central market on behalf of the wholesale buyer on the terminal market. The principal central markets for arecanuts in Mysore are Shimoga, Sagar, Birur and Tarikere. (3) Terminal markets are usually located in the harbour cities of Madras, Bombay and Calcutta where the merchants collect arecanuts of local production in India as also imported varieties from foreign countries. They distribute arecanuts to the retail markets through a class of middlemen called jobbers who collect local orders for them for a small commission. The principal terminal markets for Mysore arecanuts is Madras City, Vellore in South Arcot, Bellary, Guntur, Ongole and Razampet. Thus five middlemen operate in the distributive channel of arecanuts between the grower and the final consumer.

Defects in the trade

In summarizing the present methods adopted in the arecanut trade in so far as it relates to the growers of arecanuts in India and the ultimate consumers of their varieties, it may be said, that they (methods) increase the burden of costs both to the growers and the consumers to an unjustifiable wide extent: a host of middlemen operate in the trade channel both at the growers' and the consumers' end with the result that the margins absorbed amongst them are high; the grades have not been standardized with the result that sales are held on the basis of mere inspection and prices fixed by arbitrary modes of estimate depending upon the exigencies of the seller, and thus the seller and buyer are not placed on an equal economic footing in the deal; agreements among the dealers are suspected at the various stages of the trade system resisting quick movements in the trade, with the result that stocks are held for longer periods increasing the financing costs to the growers; only the established trade channels are used—whether or not these channels provide the best and shortest routes from the growers to the consumers, storage facilities in the different centres of the trade under central control are absent, without which a proper time and place of distribution cannot be arranged on the basis of an accurate knowledge of supply and demand conditions, so long as these and other uneconomic methods continue, the position of the growers of arecanuts continue to be as precarious as ever. The history of the growers for long has been one of continued struggle against these man-made handicaps.

Remedy

The organization of cooperative marketing societies has been the remedy offered for curing such rural ills. The Royal Commission on Agriculture in India seem to mention cooperation more frequently than any other topic, indicating their high esteem for it as a factor in education and village reconstruction. But, unfortunately cooperation in India has yet remained a scheme or a plan with us. It has not yet become a manner of life. Some more things have to be done in an order of priority, before the benefits for the produce grown by the sweat of their brows could accrue to the growers of arecanuts, who for reasons beyond their control, may be lacking in adequate capital for the improvement of their gardens, and may have remained ignorant and bound in blind prejudices lacking thereby the qualities of initiative and spirit of enterprise.

Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research, addressing a meeting of the *ad hoc* Committee which met in New Delhi recently to consider various problems connected with the arecanut industry has aptly said, 'The growing of arecanuts is a matter of vital economic consequence to thousands of families in India, whose chief means of livelihood is the proceeds of the yield of the arecanut palm they cultivate on their small plots of land'. It is as much a matter of vital significance to the Government of our country with our national leaders in the helm of affairs over there, striving for the establishment of a true agrarian democracy free from caste and feud, where cooperation is the manner of life and where the life of each one is cherished and preserved. If cooperation has to be adopted as a manner of life and its goal one for all and all for one has to touch a great need, namely that of mutual self-help among the growers of arecanuts, the State cannot continue to remain neutral any longer in the unequal duel between them (growers) on the one side and the money-lenders and a host of too many small middlemen (traders) on the other.

Central Arecanut Committee

At this juncture, it is gratifying to note that the Government of India have sanctioned the formation of a Central Arecanut Committee on the lines of other Commodity Committees under the auspices of the Indian Council of Agricultural Research, to examine and adopt measures necessary for the maintenance and improvement of the arecanut industry which has its problems on the agricultural, economic and technological sides. It is hoped that this Committee will be manned by experts who are competent to lay down policies through trained and experienced personnel.—Reproduced from *Eastern Economist*, January 16, 1948.

B. H. C.

SOME new insecticides that have achieved much popularity during recent years have been given various proprietory trade names by manufacturers in U.S.A., England and Europe, which has led to a great deal of confusion in recording the results of experiments. For instance, Dichloro-diphenyl-trichlorethane has received universal recognition under the contracted name D.D.T. but Hexachlorocyclohexane otherwise known as Benzene Hexachloride, has been called by different trade names, e.g. 666, Gammexane, etc.

In view of the desirability of having a uniform nomenclature throughout the world, the Research and Development Coordinating Committee on Insecticides of the British Agricultural Research Council recently decided to advise that this insecticide should be known by the abbreviation 'B.H.C.' as this proposal has received approbation not only in England but also in India and U.S.A. It is suggested that Entomological workers in India should refer to this insecticide as 'B.H.C.' If reference is to be made to its different isomers, the Alpha, Beta, Gamma and Delta isomers should be called B.H.C., B.H.C., B.H.C., and B.H.C. The proprietory name Gammexane (I.C.I.) will, of course, be referable only to the Gamma Isomer of B.H.C.—(*Ministry of Agriculture*, New Delhi.)

Book Reviews

AGRICULTURAL ECONOMICS OF BENGAL—PART I

By Parimal Kumar Roy (Published by the Calcutta University, pp. 228, Rs. 8).

BENGAL has now been divided into two separate provinces. This book, which was approved as a thesis for Premchand Raichand Scholarship of the Calcutta University, was written some time before the partition of Bengal took place. The value of the book has not, however, suffered in any way on this account since it studies problems on a zonal basis. Besides, most of the problems, e.g. soil erosion, soil fertility, land tenure, etc. are common to both the parts of divided Bengal.

Agricultural Economics in India is a long-neglected subject. In spite of the fact that more than three-fourths of India's population depend on agriculture, no serious attention seems to have been given so far to the planning of agricultural economy of India on a sound and rational basis. It is only recently that the attention of the intelligentsia has been focused on this problem. The book is a welcome addition to the meagre literature on the subject.

In a vast country like India, agricultural planning presupposes regionalization. No single plan is workable in all the parts of India. The problems have therefore to be tackled regionwise. Groups of lands having similar characteristics and identical problems should be studied separately. From this point of view the book seems to be specially helpful. It not only confines the scope of study to a single unit of India but also treats the problems district by district.

Part I of the book deals with four chapters, namely, physical characteristics, utilization of the land, population and land system. The more important problems, e.g. farm organization, agricultural products, communications, cooperation, marketing, etc. form the subject matter of Part II of the book. The author has taken great pains in collecting data and marshalling them in an easily digestible form. The chapters are profusely illustrated with maps, diagrams and tables. The author has shown self-restraint in confining the scope of his book to a mere exposition of facts. He has not sought to put forward any theory of his own. The former is an essential preliminary to the latter. Planning nowadays is intimately bound up with any progressive programme and those who have been entrusted with the task of guiding the destiny of our country certainly do not lack the will or enthusiasm for initiating agrarian reforms on a rational basis. Reform of the land tenure system of West Bengal is already under way. Reforms in other directions are bound to follow suit. (D.J.S.)

News and Views

WORLD RICE POSITION

DESPITE increased rice production in the Orient since the end of the war, the position remains serious. It was calculated by the rice study group which met under the auspices of F.A.O. at Trivandrum, Southern India, last May, that it would take rice-exporting countries another five years to reach their pre-war levels of export, and that even this would be insufficient to meet increased demand. The populations of Far Eastern countries are increasing out of proportion to the extension of the rice-growing areas, and although long-term schemes for raising production have been planned by many Governments, the problems of more immediate relief still remain. Some idea of this rise in population is given in the estimate that birth-rate in India climbs by 5,000,000 and in Indonesia by 1,000,000 per year.

Many rice-producing countries have already formulated their plans for additional cultivation of the crop : the Siamese Government has instituted considerable irrigation projects which are expected to increase yields by 1,300,000 tons, while the Malayan Government hopes in the next 10 years to bring 600,000 more acres under cultivation. Burma, the main exporting country, has set herself a target figure of 800,000 tons for the first six months of 1948, as against the 542,000 tons exported during the corresponding period of 1947. Her total exports for last year exceeded 800,000 tons, and this represents a very considerable achievement for a country which has undergone extensive internal dislocation. Largescale land reforms, including the abolition of absentee landlords and a revision of the whole system of land tenure, have been proposed. Siam, which is the next largest exporting country, sent only 232,000 tons of rice abroad out of a target figure of 375,000 tons, and aims at the lower amount of 250,000 tons for the first six months of this year.

In French Indo-China, it is not expected to attain the pre-war level for another seven years, and the country exported approximately 40,000 tons last year, against a pre-war quantity of 1,300,000 tons. There will be no surplus for the first half of 1948, the whole production being required internally. Over 100,000 tons of rice were imported into the Netherlands East Indies last year, and, as Java is second only to India in the degree in which population presses upon resources, it is surprising that the widespread famines which have been frequently forecast have not materialized—especially so in view of the internal disorders with which the country has had to contend. Local famines and considerable undernourishment have, however, been evident.

Malaya has nearly attained its pre-war acreage, though the rice shortage in the country is still serious ; 73,000 additional acres were put under cultivation this last season, and it is expected that yields on a further 120,000 acres will be greatly increased by the use of improved irrigation methods, fertilizers and seed. The country, operating on a low ration system, is today producing almost one-half of its total requirements, although before the war it produced only one-third. Experts are looking ahead to the development of the use of mechanization in the rice areas : in Australia and America rice is cultivated with mechanical aids, but the problem in wet tropical areas is more difficult one.

There are also plans in British North Borneo to put 1,000 acres under experimental mechanical cultivation, and it is contemplated that this region should serve as a training area for farmers until a scheme involving some 40,000 acres has been put into effect.

Looking at the Far East as a whole, it is seen that the two largest producers of rice, China and India, were unable, even prior to the war, to feed their own peoples, and from 1935-39 they imported 750,000 and 1,500,000 tons respectively. China's rice production of 2,360,000,000 bushels for the 1947-48 season represents a slight increase over the previous total, but is still 250,000,000 bushels below pre-war output. Current production in India and Pakistan is reported to have fallen below that of last year. Japan was also a deficit country, but was formerly able to meet part of its needs by imports from Formosa.

The three main rice-exporting countries prior to the war were Burma, Siam and French Indo-China, but recently Egypt and Brazil have made substantial contributions towards the alleviation of the shortage. Earlier estimates placed the total world rice harvest for the 1947-48 season at 6,950,000,000 bushels, an increase of 50,000,000 over the previous season's yield, but considerably below the 7,400,000,000 bushels crop of the pre-war period.

Figures for other areas show general increases: North American output is calculated at 99,000,000 bushels (a 6,000,000-bushel rise on the preceding year) and Mexican production is believed to be exceptionally high. Europe, which produced a 53,000,000-bushel crop prior to the war and a 40,000,000-bushel yield for the1946-47 season, will harvest, it is estimated, 47,000,000 bushels for the current period. The continent as a whole has a larger acreage under rice than before the war, but shortages of fertilizers have seriously reduced yields per acre. Spain and Portugal have devoted a further 30,000 acres to the rice crop, and Italian areas have increased by about 10 per cent. African production has also risen, chiefly due to large plantings in Egypt and Madagascar, while the rice acreage in the Philippines is the largest of any since the country's liberation.

The F.A.O. report on rice, issued last June, emphasizes the increasing requirements due to the rapidly rising population of eastern countries. 'It is abundantly clear', the report concludes, 'that there will be hunger and pressure on the world market for rice until a substantial increase in rice production in the Orient is secured'. The chief obstacles lie not only in the inadequacy of farming methods—that is, lack of mechanization and insufficient use of fertilizers, but in the system which prevails all over the east of cultivation in small plots by millions of subsistence farmers. It is, perhaps, this aspect more than any other which hampers largescale planning, and since there is little carry-over of stock from year to year, crop failures often result in localized or widespread famines when there is only a small marginal deficiency in total supply. (*I.F.A.P. News*, No. 16.)

NEW DIRECTOR-GENERAL OF F.A.O.

MR. Morris E. Dodd, United States Under-Secretary of Agriculture, has been appointed Director-General of the Food and Agriculture Organization in succession to Sir John Boyd Orr, who has resigned.—*Food Bulletin*, April 19, 1948.

AUSTRALIAN RICE PRODUCTION

LIBERAL use of fertilizers, lavish use of water and mechanization from ploughing to harvesting make Australian rice cultivation the most efficient in the world. Overall rice yield per acre is 1·75 tons, but many farmers produce 2 long tons of 4,480 lb. per acre and crops of 4 tons to the acre have been taken under ideal conditions.

Mechanization is the secret.

With mechanization it has been possible to develop the largest rice farm in the world at Wakool where 4,100 acres are under cultivation. From this mammoth farm, 8,000 tons of rice was harvested in two months by 81 men using machinery. The first step in establishing an Australian rice farm is a close contour-survey of the land. Substantial check banks are then built to hold irrigation water to a depth from 6 to 10 inches. The land is ploughed and cultivated by multiple disc ploughs and harrows drawn by tractors. The whole operation is similar to that used in the type of power farming practised by Australian wheat growers.

When the sea bed is ready, rice is sown in the dry soil by a combination-cultivator-seed-drill of the type used in Australia for planting wheat and other cereals. Sulphate of ammonia is used as a fertilizer. Sowing is done in October, after which the land is flooded from irrigation canals and then immediately drained. After germination and growth of 4 to 6 inches, the land is flooded again. This usually happens in November, after which the water is held at depths of 6 to 10 inches until the rice matures. After the rice matures, the water is drained off and harvesting proceeds in April, May and June. These are the months of late autumn and early winter in Australia. Harvesting of rice in Australia is carried out by tractor-drawn, power-driven, combination reaper-threshers which reap, thresh and bag the crop in one operation. These machines, developed and built in Australia are each capable of harvesting up to 900 bushels of paddy rice a day. The plant is a development of the Australian machine designed for harvesting wheat and other grains, but has special attachments to enable the heavier rice crop to be gathered. Each farm has its own complete plant for sowing, cultivation and harvesting. Although Australian methods of production are most efficient, her total crop is small. This is because only a small region in the Murrimbidgee Irrigation Area of New South Wales is being used for rice cultivation. Water shortage is a constant problem in Australia and it is only in such places where vast irrigation schemes make possible the great amount of water needed, that rice cultivation is possible. Even so, Australia was able to supply almost the whole of its home market with rice before the war.

Today, there is no rice on the Australian market. There has been none available to Australian housewives since 1942. Other peoples to whom rice is a staple diet receive the whole of Australia's output with the exception of a small amount available to certain classes of invalids.—*Australian Agricultural Newsletter*, Release No. AGN/190.

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 6
JUNE 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.6.48
2,800

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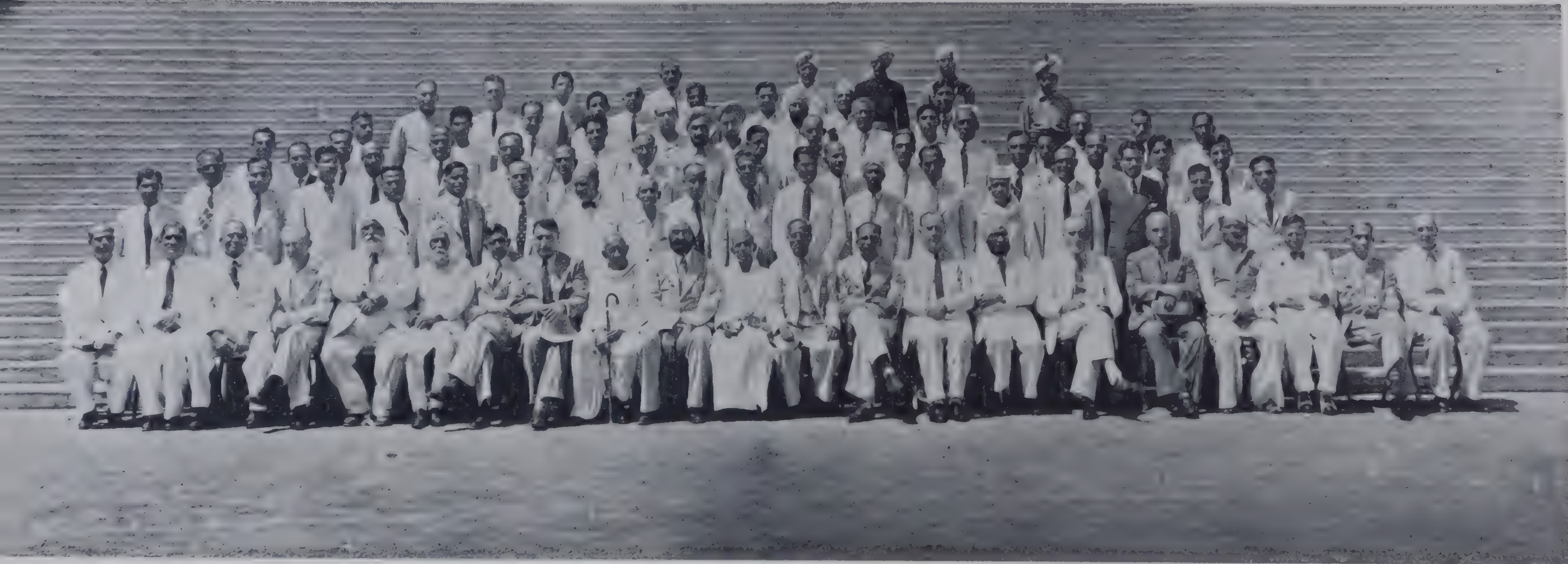
Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London WC 2.

THE SEVENTH MEETING OF THE CROPS AND SOILS WING HELD IN MADRAS ON 7 APRIL 1948



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INDIAN FARMING

JUNE, 1948

Vol. IX No. 6

THE IMPORTANCE OF THE AGRICULTURIST*

I THANK the President of the Indian Council of Agricultural Research for honouring me by asking me to inaugurate this Conference. On behalf of the Government of Madras I extend to the Indian Council of Agricultural Research a warm welcome to our province. I hope the members would enjoy our hospitality and be able to contribute much that would be of practical importance to the improvement of agriculture in this province and outside.

You all know that our country though predominantly an agricultural country is very much behind the other countries of the world in the matter of agricultural production. It is far behind the western countries in agricultural research and advance and still more backward compared to countries like China and Japan. The soil is the most important factor in agriculture. It is the gift of God to humanity. All that man can do is to see that the God-given soil is not depleted by erosion, exhaustion and other causes. It has been calculated that Nature is responsible for the provision of 95 per cent of the requirements of plant life and all that man can do is limited to 5 per cent, and even in this limited sphere all that he does is to see that the humus is not lost and the soil is not carried away by erosion and to apply manure. Plants need 13 elements like nitrogen, potassium, calcium, manganese, iron, etc. There must be intense soil survey all over the country. The survey must be not only on the top soil but also of the wealth that is found in the bowels of the earth. Research must be directed towards finding out the materials that are deficient and supplying it to the soil. Research might also be directed towards finding out suitable crops for different soils.

It will not be out of place here if I point out what is done in China and Japan in order to improve the fertility of the soil. In our country all human excreta is wasted. In China neither human faecal nor urinary matter is allowed to waste. It is used in liquid, solid and powdery states according to the irrigation facilities and condition of the soil. It has been calculated that each family gets about two rupees per head by selling its excreta of nearly 900 lb. In India we pay for excreta being removed. Whereas in China householders are paid for allowing their excreta to be carried away. You know in the Madras City alone our vast underground drainage system carries away all useful manurial stuff to the sea. It is calculated that by this waste Madras City is losing Rs. 25 lakhs according to the pre-war values; this will work to a crore of rupees according to the present day value of the manures. It is said that a Chinese farmer raises on half-an-acre of land cucumber that is produced in four acres of land in America. In addition to this, he also raises other crops in the same plot. Cultivation in Japan is so intense that the Japanese farmer pays individual attention to almost each plant. Steps to infuse the same spirit into our agriculturists should be taken.

I cannot but mention at this Conference about the importance of the agriculturist and the shabby treatment that he is receiving at the hands of the world. Our ancestors have stated even in the *Upanishads* that water is the life-giving power and food is that which gives the thinking faculty to man. It is only by concentration of thought that man is able to realize God. Knowledge pervades the whole world and some human beings attuned to the cosmic power in the world extract the secrets of Nature and give them to the world. But they cannot do so unless they have food. This was very well-demonstrated by a practical example by Udhalaka and Swetakethu mentioned in the *Upanishads*. That is why also even the Tamil literature mentions that the man who gives food gives life. For producing food, the agriculturist needs land, water, cattle, seed and manure. He needs the help of his fellow human-beings, of cattle, birds and even insects. He gives his very life in order to produce the food on which all of us thrive. But every one else in the world, labour, capitalists and middle classes are crying for security. The agriculturist alone has no security. He is the plaything of all the blind forces of the world. He is at the mercy of the rains, of his fellow human-beings and what is it that we give him in return ? Do we give him any security ? Does agriculturist get any protection or subsidy from Government as industry does ? Is there any assured water supply ? Is there any crop, cattle or famine insurance ? Does he get an assured market or price ? Has he got anything to look forward to ? It has been calculated that out of 72 lacs of *pattadars* in the Madras Presidency, about 66 lacs have only uneconomic holdings. Therefore these 66 lacs of *pattadars* all the time have no other idea than to struggle to find ways and means of making both ends meet. How can any one thrive or able to think of higher things while he has to wage his struggle for existence daily ? Have our scientists made all discoveries necessary to enable the agriculturist to carry on his agricultural operations with profit to himself and to others ? Have our Governments carried the knowledge which our scientists have extracted from Nature to the doors of the agriculturists ? Do they give them the necessary help to utilize those discoveries ? When are we going to have scientists like Burbank of California or Michurin of the Soviet Russia who working in the same field as Luther Burbank proved that under suitable conditions young hybrid seedlings can be trained to develop any desired characteristics. Michurin took hardy wild plants from Siberia, Canada and various mountain regions and crossed them with delicate southern plants. The cross-breeds so obtained inherited all the hardihood of the wild flora. They resembled their delicate parents of the South in tastiness, brightness of colour, largeness of fruit. He evolved 300 valuable varieties of fruit. When are we going to have anything like the contribution of Soviet scientists in the matter of animal husbandry ? When are we going to progress in matters like vernalization of seeds and artificial insemination of cattle ?

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* Inaugural speech delivered by the Hon'ble Sri O. P. Ramaswami Reddiar, Premier of Madras, at the seventh session of the Crops and Soil Wing.

We are astonished to hear that in the Karavayevo State Dairy Farm the yield of milk in 1938 was 6·15 tons per cow in a herd of 251 cows, that one particular cow yielded nine tons of milk and another cow, reared on the same farm, yielded 16·3 tons of milk during her sixth lactation.

Our agriculturist has to suffer for anything that he needs. Everything comes from the raw products, body, mind, intellect, wealth, enjoyment; but the producer of the raw products has no opportunity to build up his body or develop his mind and intellect or to accumulate wealth or enjoy anything in the world. How much effort does he put forth in producing the raw products ! But while the producers of raw products suffer, the industrialists and manufacturers who only give a small change or turn to the primary products get all the best things in the world. It is on the labour of the agriculturist that you and I, all Governments, middle classes and industrialists are prospering. What are we going to give him back in return ? Have our Governments given any help to the agriculturist ? Do they give him the necessary credit facilities or agricultural implements or manure or even do any research work and carry the results of the research to him ? The scientist must come to the rescue of the agriculturist by making newer and newer discoveries and the Governments must help the agriculturists by taking those discoveries to the agriculturists and also help him to utilize these new discoveries. We must all pay attention to items of constructive work suggested by Gandhiji and make the villages prosper. Let me hope that your efforts would succeed in bettering the lot of the agriculturists of this country.

Original Articles

INDIAN FISHERIES

By BAINI PRASHAD

THE available supplies of food in India are far from sufficient for meeting even the minimum needs of the ever-increasing population in the country. The diet of the majority of the people, who subsist mainly on cereals, is not only highly ill-balanced, but very deficient in respect of essential elements, such as proteins or body-building materials, vitamins, trace elements and assimilable fats. Fish has generally been accepted as a food which can make substantial contribution towards making good these deficiencies, but the available supplies from the undeveloped fishery resources of the country which so far have received scant attention either at the hand of the authorities or the general public are quite insufficient for meeting even the minimum needs of the fish-eating public.

Bold programme needed

Fish is eaten by nearly 50 per cent of the population of India, but with the extremely limited supplies not more than 2 oz. of fish per head per week is available, and this at prices which are often beyond the reach of the majority of the consuming public. If people are to have an adequate supply of this essential article of food, the present output of roughly 6,40,000 tons must be increased by about 10 to 11 times. It is not difficult to reach this target if a bold programme, on an all-India basis, of biological, hydrographical and technological research, and pilot commercial fishing with power crafts and gear, is carried out for developing the extensive and varied fishery resources of this vast sub-continent and the seas surrounding its coasts. Without a programme that deals comprehensively with all aspects of development, conservation, exploitation and utilization of these resources, improving the socio-economic position of the fishermen and supplying them with more efficient power crafts and gear and organizing the development of the fishing industry is bound to be painfully slow, and no results of any value are likely to be achieved for a long time to come.

Research work essential

Fisheries which have been and are exploited in India are those of the inland and coastal waters in a zone not extending much beyond the five-mile limit, while the rich off-shore and deep-sea fisheries along the extensive coast line are, for want of essential information about the fisheries and the absence of power crafts and gear, hardly touched. Not only have these waters to be explored with regard to the most suitable and productive periods of the year, but the types of power crafts and gear most suited for their exploitation have also to be ascertained by extensive pilot experiments. Fish, further, is a highly perishable commodity, and the primitive and highly defective methods of handling, treatment, transport and storage in vogue in all parts of the country are responsible for the wastage of a very large percentage of even the relatively limited output. All these require a great deal of research and experimental work for their solution, but unfortunately no adequately staffed and properly equipped agencies were so far available for tackling the multifarious and intricate problems involved.

State help necessary

Fisheries Departments have been started in a number of provinces and States within the last 40 years or so, but for want of the requisite trained staff, essential biological, hydrological and statistical data, research and experimental facilities, they have not been able to serve as efficient agencies for the improvement and development of fisheries,

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amelioration of the socio-economic position of the fishermen, organization of the fish trade, conservation and improvement of the fisheries, and above all increasing fish supplies in the country. As a part of the 'grow more food' campaign of the Government of India, a number of *ad hoc* schemes for increasing fish production with the help of the Central Government were started by various provinces and States since June 1944, but with limitations imposed by the lack of essential data, trained personnel and essential equipment, it has not been possible so far to adopt a concerted and long-range policy for developing all classes of fisheries of the country on sound scientific lines.

In all European and American countries where the fishing industry has been properly developed, the State has had to play and is playing a very important part in supplying the necessary machinery for fundamental research, experimental and pilot exploration work. State help is necessary not only because of the scale and nature of the organization and equipment required, but also because fishing outside territorial waters, though regulated by international conventions, is free for exploitation.

Problems of fishery research

It is hardly necessary to mention that fishery research is uniquely difficult because the medium in which fish live is in constant motion and is subject to cyclical and short-term changes. This is more particularly the case with marine fisheries. Hydrographical researches covering studies on temperatures, salinity and currents, and also involving an understanding of the changes in the amount of time taken in and the extent of flow of water masses from adjacent or distant areas are fundamental to unravelling the life-histories of different species of edible fish. In most cases, the early stages of these species are at the mercy of the wind and waves both in regard to their food and their movements. Continuous observations on the microscopic plants and animals—plankton—are also essential from several points of view. These plants and animals constitute the food of fishes or of the animals upon which the fish feed, and are therefore of fundamental importance. They are also indicators of the original water masses by which they are carried and in certain circumstances their presence or absence in large numbers may seriously affect the course of progress of fish migrations.

Research is essential on the nature of sea-bottom and the animal population which vary from area to area, as on these depend not only the types of food fishes but also the numbers which different fishing grounds are able to support. For investigations which deal with changes in the composition of the stocks of fishes themselves with the object of assessing the effect of fishing intensity upon the stocks and forecasting the broods of particular years which are likely to determine the catches of later years, large research organizations both on land and sea are required. Continuous examination of the fish landed at various key ports in regard to species, quantity, weight, sexual maturity, age and size is essential. In order to have a complete picture the results of these studies must be supplemented by work carried out on vessels by specially trained staff and even on the vessels of fishing fleets.

For inland fisheries pond culture has been rightly accepted as one of the most fruitful ways of increasing supplies. In the United States there are some 300,000 farm and ranch ponds of an area of 360,000 acres, while within recent years in connection with soil conservation programme, some 23,000 ponds have been constructed and stocked with food fishes. The annual fish yield of such ponds per acre was 150 lb. but by using artificial fertilizers this yield has been increased to 400 lb. and even yields of up to 1,000 lb. have been recorded. In India pond culture has been carried on extensively for centuries in several provinces, particularly in Bengal and parts of Bihar, but the yields generally are low, and large scale research and experimental work are essential before yields could be materially increased. The same is true of other classes of inland fisheries, like those of rivers, lakes, canals, backwaters, etc.

Technological research is necessary not only in regard to the crafts and gear used in fishing but also in connection with the proper handling, preservation and transport of fresh fish, preparation of processed fish products, and the manufacture of fish meals, manures, fish oils, fish glue and other by-products. Such work cannot possibly be carried out by different provinces and States independently and must be the responsibility of a central agency for the whole of India. It would otherwise involve a great deal of duplication of effort, both in regard to the personnel and equipment, and unnecessary wastage of talent and of the limited funds which might be available for such work. In the case of the North Sea, for example, the 15 nations bordering on the North Sea, while each maintaining fairly large research establishments for fishery work, established an International Council for the Exploration of the Sea in 1902 with its headquarters at Copenhagen. While local problems are dealt with by the fisheries departments of the countries concerned, all fundamental problems in regard to the fisheries of the area as a whole are the concern of the International Council, and grants are made by the member countries to this Council for carrying out fundamental research. Similarly in the case of Canada, while various provinces maintain fisheries departments and small research staff, fundamental research problems for the country as a whole are dealt with by the Fisheries Research Board of Canada with separate stations for work on marine fisheries of the Atlantic and Pacific Coasts, and the inland fisheries, and two stations for dealing with technological problems.

In much the same way, there is the Federal Fish and Wildlife Service for dealing with the fisheries of the United States as a whole as a separate organization from the fishery departments of the various States of the Union. In addition, the North American Council on Fishery Investigations is an informal organization established by Canada, France, New Foundland and the United States for the purpose of coordinating oceanographic and fishery investigations in the western North Atlantic. The International Commissions established jointly by the United States and Canada for dealing with the Halibut and the Salmon fisheries in the North Pacific are examples of successful joint action by the two countries for the conservation and development of the very valuable fisheries in this area. Similar Councils, which were set up for the Mediterranean and Adriatic Seas, did very valuable work for the development of the fisheries of those areas.

Contrary to popular belief, all seas are not full of fish. Temperature of the sea, depth of water, currents, extent of the continental shelf, nature of the sea bottom, and the abundance of food organisms generally determine the richness or otherwise of the fisheries. The great fisheries of the world have been developed by the maritime nations of the Northern Hemisphere and the abundant resources of that half of the global waters have been fished with great intensity and skill.

Development of fisheries in Japan

Japan held the first place amongst the fishing countries of the world in pre-war years. Its output of marine products in 1936 was estimated at 28·3 per cent of the total world production or roughly 5,000,000 metric tons, being greater than the combined production of the three leading fish-producing countries, viz. the United States and Alaska 11 per cent, the United Kingdom 6·4 per cent and Norway 5·3 per cent of the total world production.

The question may well be asked as to how Japan in so short a time attained almost the topmost position amongst the fishing nations of the world. The answer is very simple. Necessity was the main driving force and properly planned and whole-hearted efforts of both the Government and the people resulted in bringing about the great development of the industry. Only 16 per cent of the total land area of Japan proper can be utilized for agriculture, and, as is apparent, this did not and cannot produce enough food for an ever-growing population. Further, as in the case of production, the Japanese lead all other nations in the consumption of fish as food. The total consumption of fish in Japan before the war was estimated at some three million tons annually, while the annual consumption per head was about 95 lb. For meeting the urgent demands of the home market in the first instance and later to develop a very extensive export market, inland fisheries, which were already being utilized to the maximum, were supplemented by extensive development and exploitation of the marine resources around Japan. The Japanese Government realizing the urgency of the problem planned on an extensive scale. They made a start by sending abroad large bands of Government officials and businessmen for studying the methods for the development and exploitation of fisheries followed in other countries. The best of the foreign methods and processes evolved for the development and exploitation of fisheries were adopted with necessary modifications to suit the needs of the Japanese fishing industry. Large numbers of research vessels were employed to explore every part of the Pacific for fish, and this line of work was extended even to the Atlantic, Indian and Arctic areas. At home, fisheries schools were established to train personnel for the ever-increasing needs of the rapidly developing industry. Training began early in the grammar schools, and before the second World War, 500 to 600 such primary schools had courses of training in fisheries. In addition, there were over 30 specialized schools for higher fishery courses in the 24 Prefectures of Japan. Lastly, there were two fishery colleges, and three of the seven Imperial Universities had well-organized Fishery Faculties. One of the colleges, the Imperial Institute in Tokyo, was administered by the Japanese Bureau of Fisheries independently of the Education Ministry. Technological and biological laboratories were established throughout the country and as a result six federally sponsored laboratories and 112 Prefectural laboratories were working in Japan before the War. Even the latter were granted subsidies and grants for their work from the Central Government. One of the laboratories located at Yoichi in the island of Hakkaido was recognized as the best equipped and largest fishing laboratory in the world. Outside Japan proper, there were 14 research fishing stations in Korea, five in Formosa, one in Karafuto, one in the South Seas, one in Kwantung and three in Manchuria. These laboratories and research stations carried out intensive work for developing new methods and processes of fishing, and conducted researches on fish migration, fish population, fish reproduction and growth, and other multifarious problems providing essential data for the conservation and development of the fisheries. Detailed studies were carried out to make every water area around Japan productive. Fish farming was carried out on a very extensive scale in bays and estuaries, as also in the fresh water lakes and ponds, and the operations were so planned as to yield regular crops. Even rice fields were utilized for the culture of special species of carps and the produce from this source alone in 1946 was estimated at over 7,000 tons. In addition to these, the Government sponsored research agencies ; there were a fair number of laboratories and stations operated by private fishing companies. Large vessels were built for research on various classes of deep-sea fisheries, such as pelagic, midwater and demersal. Practically every Prefecture along the sea coast had some sort of a fishing research vessel for carrying on investigations and pilot fishing in its area. Large shipbuilding yards and fishing harbours were developed all-round the coast both for the construction and repair of the fishing fleet, and affording places for safe anchorage.

As a result of the War, a large part of the Japanese fishing fleet was destroyed but soon after the Armistice, the Japanese Government took immediate steps for rehabilitation of her fisheries. With the approval of the Supreme Commander, the Japanese Government started operations with such vessels and gear as could still be used, and simultaneously started an extensive programme of repair and construction of old and new vessels and equipment. The Japanese were neither given nor did they ask for any help for rehabilitation of their fisheries, but only requested permission for starting fishing operations, and to build, purchase or charter fishing vessels from whatever source they could be acquired. In addition to rehabilitating her fishing fleet, Japan started taking immediate steps to repair and improve her fishing harbours, many of which were badly damaged during the War. Incidentally it may be mentioned that in the pre-war years, the Japanese Government had spent large sums on the development and construction of fishing harbours and providing all possible facilities for fishing vessels and the industry. There were a large number of natural harbours around the Japanese coast but a great deal of work had to be carried out to improve them by the construction of piers, sheds, ware-houses, loading and unloading contrivances, cold-storage plants and so on. The cost of effecting these improvements was shared on a fifty-fifty basis by the Central and Prefectural Governments and in all some 135 up-to-date harbours had been built prior to the War. The cost of building these harbours was estimated at about 67 million yens or about 67 million rupees as the exchange value of yen at the time was about a rupee. In connection with the work of rehabilitation of the harbours after the War, one instance in which despite the disturbed economy of the country over eight million yens were allocated for reconstruction and repair of one fishing harbour only is of special significance.

I have included the above rather detailed review of the developments of fisheries in Japan based on a recent account by Dr Fiedler, Head of the Fisheries Division of the Supreme Commander's Staff, to indicate how fisheries in that country were developed in less than half a century to a very high standard of efficiency through careful planning and cooperation of the Japanese Government and the fishing industry. The Japanese Fisheries Fleet before the War had 366,000 fishing vessels and employed some 1,500,000 persons.

Commercial fisheries in India

The catch of a fisherman in a given period of time depends on his equipment, his efforts, and on the fish available at the time and the place where he uses his gear. The more his equipment confines him to inshore fishing, as in the case of the Indian fisherman, the more must his catch depend on the inshore run of certain species, most of which are seasonal. And further in the case of inshore fishing there is an ever-increasing drain on the supply owing to the large concentration of fishing effort in a limited area. More mobile and efficient equipment, on the other hand, increases his range of fishing and his potential catch. In this connection, figures of the average catches of fishermen from a few selected areas are of interest. In Sind from the very good fishing grounds not far from the coast line average annual catches per fisherman have been estimated at not more than 4,500 lb. On the other hand on a United States trawler the catch of large fish, such as Cod or Haddock, is 80,000 lb. per man per annum, while in the California Sardine Fishing it rises to as much as 2,00,000 lb. of edible portions of fish. This proves beyond doubt how uneconomical and wasteful are the present methods of fishing in the Indian waters, and how vital it is to adopt modern methods of fishing for the development of our commercial fisheries.

Within the last decade or so, a few power-propelled carrier launches have been introduced in India for the transport of fish from outlying fishing areas to the consuming centres like Bombay and Calcutta, but in general the fishing industry is dependent on indigenous crafts of a displacement of seldom over five tons. Consequently fishing operations have in general been limited to not more than five to seven miles from the shore, while more modern and efficient types of tackle cannot possibly be used by human labour from such frail crafts. Further, in the case of such a highly perishable commodity as fish the chances of the catches from the outlying fishing grounds reaching the consuming markets in a fresh condition are greatly reduced when these have to be carried by slow-moving small crafts almost entirely dependent on weather and tides, and in which for lack of storage space catches cannot be preserved even in ice. Finally, in the absence of cold storage and distribution facilities on shore, the catches have to be disposed off or consumed soon after arrival, or processed into dried and salted products of a very poor quality by highly primitive and wasteful methods. As an almost exact parallel to the conditions prevailing in India at the present day may be cited the case of Hawaiian fisheries. In 1900, two years after the annexation of the Hawaiian Islands by the United States of America, the yield of the commercial fisheries consisted of some 129 species of fish with total estimated landings of 6,220,000 lb. for the seven major islands. The number of wholetime fishermen was estimated at 2,300 and the number of boats of various types at 745. The primitive and extremely diverse types of fishing gear consisted of gill nets, cast-nets, seines, bag-nets, dip-nets, scoop-nets, spears, baskets, and traps of various kinds. Power crafts and improved modern nets were entirely unknown. Between 1900 and 1938, a complete change was effected in the fisheries of these islands. From the primitive inshore fishery with its scattered units of one or two men crews operating from small and widely separated villages, they are now concentrated mainly in the major fishing ports and fishing is carried out by larger communities. In 1938 there were 2,670 licensed fishermen in the territory, who employed 999 licensed fishing boats, exclusive of a small number of primitive canoes. Two-thirds of the commercial catch, which in 1937 amounted to 19,176,000 lb. valued at $1,501,000 was taken with motorized fishing vessels, and the individual fishermen with their improved canoes and nets were also able to bring in much larger catches.

In other lands

The remarkable development of the commercial sea fisheries in Canada and the United States of America is to be attributed directly to the phenomenal improvements in, and great capital investment on, modern crafts and gear. In 1943 the capital investment in Canada represented by the vessels, boats, nets, traps, piers, wharves, etc. concerned in the exploitation of sea fisheries was valued at $25,104,273 showing an increase of $2,042,602 over that of 1942. A part of the increased returns has to be attributed to increased prices, but as these were generally controlled by the Federal Government and since the number of fishermen had not increased in proportion to the larger catches, the increase has been explained as being the direct result of greater capital investment on more efficient power crafts and gear.

In the United States of America, the capital invested by fishermen and boat-owners on crafts and gear amounts to some $3,343,000,000. The initial value of fish landings for this investment has been computed at $174,300,000 and the annual profit to the fishermen and boat-owners at $133,720,000. In 1939 the total number of power vessels of over five ton displacement employed in fishing was : steam 100; diesel motor 5,105 ; sail 208 ; small motor boats 31,809 ; other boats 36,735 and accessory boats 2,083. The total catch of sea fish secured by these crafts along the United States and Alaska coasts during 1939 was 4,285,711,000 lb.

In the United States the Pacific Fisheries are conducted on most modern lines and the methods of fishing, packing, transport and distribution, and the equipment used in their working, reflect high technological knowledge, skill and management. Technology, science, experience and finance all have played very important roles in industrializing these fisheries and adding to their efficiency. The perils of fishing have been lessened to an appreciable degree by the use of high-power diesel engines, and modern vessels equipped with radio compasses, echo sounders, automatic helmsmen and two-way radio telephones. All these appliances, which now form standard equipments of the Pacific fishing crafts, have not only greatly widened the fishermen's radius of action, but have also contributed very materially to their increased catches and larger incomes. In short, the equipment and methods employed in the Pacific Fisheries are very highly evolved, with mechanization carried to the maximum possible degree. As a result the average annual catch of fish per fisherman is 63,500 lb. from the highly productive fisheries of the Pacific as against 20,200 lb. in other parts of the States. The Government agencies concerned with the fisheries are materially contributing to the development of the fishing industry by granting subsidies, bounties and various types of credit facilities for the furtherance of this industry. With the development of this highly efficient productive machinery the methods of handling, distribution and utilization of fish have received equal if not more attention. Not a fraction of fish catches, not even the offals, is wasted. With the well-organized and developed machinery for canning, freezing and cold storage, the distribution of fish over long distances has been made possible.

In Great Britain out of the fishing fleet of 1,474 trawlers, some two-thirds were bought or requisitioned by the Admiralty. Some 383 were lost during the Second World War, and only a hundred or so were able to carry on fishing. More than 200 have been reconditioned since the close of the war and a very large number of new vessels are being built. It is also of interest to note that for the re-equipment of the inshore fishing industry, the Government was allowed by an Act of Parliament in 1945 to make grants not exceeding £ 500,000 and advance loans not exceeding £ 800,000. Similarly an allocation for assistance of £ 1,700,000 had been made available to the Herring Fisheries by the Herring Fishery Act of 1944.

According to the latest information, China has planned with the help of the United Nations Relief and Rehabilitation Administration to have a very large and most modern fishing fleet in her history. The cost was estimated at £ 10,250,000, and the scheme included the acquisition of 750 power vessels, 1,000 fishing boats, 12,000 wooden junks of all sizes and some 50 cold-storage plants. Thirty dockyards are to be started in various parts of the country to deal exclusively with the building and repairing of fishing crafts. For rehabilitating fisheries, 44 million dollars were spent by the U.N.R.R.A. for the supply of fishing boats, gear, and other necessary equipment to China, Greece, Yugoslavia and Poland. In addition to operational equipment, the U.N.R.R.A. also arranged for the supply of refrigerated storage, and equipment for canning and processing fish.

Developing Indian fisheries

As the Fish Sub-Committee of the Policy Committee No. 5 on Agriculture, Forestry and

Fisheries in its Report indicated, 'the produce of the marine fisheries of India constitutes about two-third of the total fish supplies in the country. The relatively large quantity is mainly the product of the foreshore fishing areas. To increase fish production the extensive off-shore fisheries have to be exploited and for this bigger boats and better gear are essential'. As no detailed information in regard to fishing areas and grounds in the form of a Close's Chart of the North Sea or the Fishery Charts for the Pacific and Atlantic coasts of the North American area is available and, but for the experimental work of the three steam trawlers, '*Golden Crown*', '*William Carrick*', and '*Lady Goschen*', no detailed information is available regarding the annual and seasonal fishing productivity of different areas, the Sub-Committee remarked, 'It is essential to discover and locate the good fishing grounds, the seasons of abundance of fish, and to employ efficient fishing craft and tackle. After the fishing grounds have been located and properly charted, it would be necessary to make available power boats and trawlers for their proper exploitation either through large commercial concerns or what we consider proper, by organizing the fishermen on cooperative basis and supplying them with power crafts and nets through the grant of subsidies and loans from public funds'.

Unfortunately this work of planning has progressed at a very slow rate and even the Central Government Scheme of Pilot Fishing to serve as floating experimental centres is just being started. In view of the very backward nature of the fishing industry and the indigent condition of fishermen in the country and the comparatively very little interest taken in the industry by large commercial interests, it was felt that such pilot research and exploration by the Central Government in different zones was essential for enabling the Provincial Governments and private commercial firms to start development schemes on an appropriate scale. For this purpose six pilot fishing centres based on the six major ports of India—Karachi, Bombay, Cochin, Madras, Vizagapatam, and Calcutta—were selected. The boats in each centre were to have fishing gear such as Danish-seine nets, Purse-seine nets, gill-nets, lines, beam and otter-trawls with winches on deck to operate them at varying depths and were to be fitted with complete freezing equipment for the preservation of the catches on board the vessels which were meant to cover an operational radius of about 200 miles from the ports mentioned. These vessels, it was hoped, would explore, chart and assess the fishing possibilities of the grounds and banks along the entire coastline of India, serve for the training of the personnel in the use of such crafts and modern types of gears, and test and demonstrate the most suitable methods of preservation of fish from the time it was caught to its delivery in the retail markets. This scheme also envisaged the setting up of cold-storage plants in the ports mentioned for storage pending distribution, and thus ensure regular continuous supplies all the year round to the inland markets from the landing ports. In addition, a Central Fisheries Research Institute with a number of stations for dealing with technological problems and those of inland and marine fisheries was to be started. A beginning has just been made in this connection, but it will take several years before all the stations can begin to function.

At the present day the catch of sea fish along the entire coastline of India which is roughly two-thirds of the total fresh fish production of the country, amounts to 457,000,000 lb. a year. This amount, it may incidentally be noted, is about one-fourth of the yield of commercial fisheries of the Pacific Coasts of the United States for the States of Washington, Oregon and California as it was in 1939. Of the yield in India about 50 to 60 per cent, which cannot be transported as fresh fish to the distant inland markets, is converted into very poor types of dried and salted fish by most unhygienic and wasteful methods. It was hoped that by introducing a better and up-to-date agency for the preservation and transport of fish in the main fishing centres this very valuable food could be better utilized and made available in as fresh a condition as possible to the large fish-eating population of the country.

The prosperity and development of the fishing industry of any country is naturally dependent on the socio-economic position of its fishermen. The fishing industry in this country is neither organized nor is it localized in any area or areas. The fishermen generally belong to a very low stratum of society, and fishing is invariably regarded as one of the meanest of all trades or professions. The fishermen are generally illiterate and no real attempts have been made in any part of the country for giving them academic, vocational or industrial training. They are highly individualistic in outlook, and are in no way concerned with the proper marketing and cost-profit calculations of their produce. They are generally in debt and have no hope of ever being freed, under the existing conditions, from the clutches of the money-lenders. This human element in the industry is a problem for those who are responsible for the development of this backward industry.

Conclusion

To sum up, the rapid development of commercial fishing in India depends on a series of innovations, such as the use of suitable modern types of power crafts and gear on a large scale for working various classes of fisheries, the training of personnel required for these fishing vessels, the development of ship and boat-building and port facilities, the provision of ice and cold-storage facilities on board the fishing and carrier vessels, the establishment of chains of cold-storage plants on shore for preservation, storage and regular distribution of the catches, the provision of rail refrigerator-cars and road refrigerator-trucks, the improvements in storage conditions at wholesale and retail centres, the inspection and grading of products and utilization of surpluses by up-to-date methods of canning, salting, drying, etc. and of wastes and inedible species by the development of by-product industries. Such changes will reduce losses and deterioration of the products, make available more regular and larger supplies and, while providing an equitable wage to the poor fishermen, materially reduce the price spreads. Finally, as in all other countries, the development of the fishing fleets would provide the training and recruiting grounds for the personnel required for the Mercantile Marine and Naval Forces of the country.

PHOSPHATE MANURING OF LEGUMES IN RELATION TO GREEN MANURING*—IV

By C. H. PARR and S. SEN

EXPERIMENTS carried out at the Indian Agricultural Research Institute, New Delhi, and its sub-station at Karnal (Punjab) during the last five years have shown how phosphatic fertilizers can improve the yields of legume crops, particularly legume fodder crops, such as berseem, lucerne, *senji*, *methra* and *guar*, increase the phosphate, calcium and protein contents of the herbage so produced and assist in the building up of soil fertility of a stable type by which high yields of cereal crops following in the rotation can be ensured[1], [2]. It has been shown that in the presence of ample supplies of available phosphate, the legumes, particularly the clovers and other leafy fodder legumes, are able to make luxuriant growth and, with the aid of the symbiotic root nodule bacteria, build up a large quantity of nitrogen which is left behind in the easily decomposable root residues when the crop is cut and removed. Evidence is accumulating to show that the method will provide means whereby soil fertility, based on adequate supplies of organic matter and nitrogen taken from the air, can be built up in Indian soils by methods which most cultivators are in a position to employ.

Green manuring to enrich the soil

This article deals with the effect of phosphate when used with legume crops grown specifically for green manuring. Most Indian soils are lacking in both organic matter and nitrogen. To restore a fair level of fertility and ensure a high average of crop yield, occasional green manuring, with a legume crop, would appear to be just what these soils require. Heavy crops of suitable legumes can be easily grown during the *kharif* season. By mid-August or early September they are fully grown and ready to be ploughed in, to provide all the organic matter, and, it would appear, all the nitrogen required by the *rabi* crop which is sown in late October. In practice, however, it has not proved to be as easy and straightforward as this would suggest. When used as a method of manuring for *rabi* cereal crops, conflicting results have been obtained. A satisfactory technique, which can be relied upon to give a better return than the usual cultivated fallow or that obtained by taking an extra grain or money crop in place of the green manure crop has not as yet been worked out.

Organic matter and soil nitrogen

The decomposition of the organic matter of the green manure crop in the soil is brought about by a large number of different types of organisms. In the process, they use up large quantities of nitrogen taken from the same organic matter and also from the soil. As the organisms multiply and grow, the nitrogen is converted into the material which goes to make up their body structure. As decomposition proceeds, the types of organisms which take part vary according as the different stages reached in the process provide the type of material which forms the particular food required by each group to multiply and grow. When the particular food material of any group is used up many of the groups die off, and in turn, become food for other groups which carry the process one or more stages further.

Thus, the nitrogen present in the soil, when the legume green manure crop is sown, is taken up by the legume crop together with considerable quantities of nitrogen from the air, but whilst the crop is growing and whilst it is being decomposed, this nitrogen is temporarily locked up in the green manure crop and does not

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* Paper read at the 34th session of the Indian Science Congress held at Delhi in January, 1947

[1] Parr, C.H. & Bose, R.D. (1944). Phosphate manuring of legumes, *Indian Farming*, **5**, 156-162

[2] Parr, C.H. & Bose, R.D. (1945). Phosphate manuring of legumes, II, *Indian Farming*, **6**, 201-208

become available again to the following cereal crop until it has been fully decomposed.

Conditions favouring decomposition

Generally speaking crops take in most or all the nitrogen they require very early in their growth. With *rabi* crops this period is usually the first two months after germination. It is therfore very essential that ample supplies of available nitrogen (nitrate) are present in the soil during this period. If the decomposition of the major portion of the organic matter of the green manure, and of the bodies of the many groups of organisms which have taken part in its decomposition, is not complete and the locked up organic nitrogen not converted back to mineral nitrate, adequate supplies of nitrogen will not be available to the cereal crop just when they are most needed to ensure the preliminary growth necessary for high yield. Successful use of green manuring for the *rabi* cereals depends on soil conditions being favourable for rapid decomposition between the time of ploughing in of the green manure and the germination of the *rabi* crop. The nitrogen locked up in the green manure crop has to be liberated and converted into nitrate before it is of use to the cereal crop. Since growth is roughly in proportion to the amount of nitrate available during this period, any shortage is reflected later in reduced crop yield. This consideration is vital to the success of green manuring as a practice.

The speed with which decomposition takes place depends on how far soil conditions such as moisture, soil aeration have favoured the growth and multiplication of all the organisms concerned. As these conditions are largely dependent on the monsoon, the results of green manuring for the *rabi* crop are as variable as the monsoon itself. It is necessary to remember also that the green manure crop itself uses a large volume of water which must be replaced either by late monsoon or irrigation if the decomposition processes are to proceed favourably and the following crop is not to suffer from lack of moisture.

Green manuring recommended for sugarcane

The practice is usually recommended to crops like sugarcane for which there is ample time between the date of ploughing in the green manure and the planting of the cane for the conversion of sufficient organic nitrogen into nitrate to meet the needs of the cane crop. Alternatively wherever a green manure crop can be grown during May and June before the *kharif* crop is sown, green manuring for maize, cotton or paddy can be recommended because the decomposition processes are very rapid during the hot weather and early rains, and organic nitrogen is converted into available nitrate more quickly during this season than during the *rabi*. The *kharif* crop grows during a period of relatively steady high temperatures and high humidity. On the other hand when the *rabi* crop is sown, temperatures and humidity are rapidly falling and bacterial activity is slowing down which makes it imperative that ample stocks of nitrate are available in the soil before the crop is sown.

Whenever a green manure crop can be grown and ploughed in before the *kharif* crop is sown, green manuring would appear a more reliable practice for the *kharif* than for the *rabi*. But since water for growing such a green manure crop during the hot weather is not usually available, the necessity of developing a successful technique and of maintaining soil fertility for the *rabi* crop is a pressing one.

Pusa permanent manurial trials

In this connection the results of the permanent manurial trials carried out at Pusa extending for a period of 36 years, between 1908-09 and 1943-44, in which green manuring treatments occupied an important place, are of considerable interest (Tables I and II)†. In the course of this period certain changes were made in the treatments in these long term experiments. In 1913-14 an extra treatment of green manuring with sunn hemp in conjunction with superphosphate was added and in 1930-31 the treatments were modified as given in Table II. Bose and Menon[3, 4] when dealing with the results of these experiments, have not considered the interesting results obtained from this treatment of green manuring in conjunction with phosphate.

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†Since 1936-37, these experiments have been continued by the Imperial Economic Botanist to whom the authors' acknowledgements are due for the yield data for the years 1937-44.

[3] Menon, T. V. G. & Bose, S. S. (1937). A Statistical Study of the Yields of the Permanent Manurials, Pusa, *Indian J. agric. Sci.* 7,193-204

[4] Bose, S. S. & Menon, T. V. G. (1937). A Statistical Study of the Deterioration of Yields of the Permanent Manurials, Pusa. *Indian J. agric. Sci.*, 7, 205-223

TABLE I

Total yields of crops in maunds per acre, 1908-09 *to* 1929-30

Plot No.	Treatments per acre per year	1908-09 to 1912-13 (5 years)		1913-14 to 1929-30 (17 years)	
		'A' Series	'B' Series	'A' Series	'B' Series
1	No manure	124·4(10)	89·2(10)	266·4(34)	232·2(34)
2	Farmyard manure 10 lb. N	125·1(10)	106·6(10)	325·4(34)	304·5(34)
3	Farmyard manure 20 lb. N	145·8(10)	117·7(10)	379·6(34)	351·9(34)
4	Farmyard manure 30 lb. N	136·1(10)	111·5(10)	421·2(34)	365·6(34)
5	Rape cake 20 lb. N	128·5(10)	116·7(10)	334·2(34)	286·1(34)
6	Ammonium sulphate 20 lb. N	111·0(10)	88·5(10)	230·6(34)	214·2(34)
7	Potassium sulphate (K_2O) as in farmyard manure No. 3	99·6(10)	79·1(10)	208·9(34)	190·8(34)
8	Superphosphate, (P_2O_5) as in farmyard manure No. 3	132·9(10)	114·4(10)	344·2(34)	290·1(34)
9	Superphosphate and potassium sulphate, (P_2O_5) and K_2O) as in farmyard manure No. 3	127·6(10)	119·9(10)	319·7(34)	286·7(34)
10	Ammonium sulphate, superphosphate and potassium sulphate (N, P_2O_5 and K_2O) as in farmyard manure No. 3	146·3(10)	133·9(10)	401·9(34)	338·9(34)
11	No manure in a cereal rotation	78·2(10)	86·1(10)	143·9(34)	149·4(34)
12	Green manure in a cereal rotation	86·5 (8)	70·9 (7)	155·4(25)	177·6(26)
13	Deep-rooted legume in cereal rotation	114·9(10)	90·3(10)	204·6(34)	196·2(34)
14	One deep, one shallow-rooted legume in the rotation	115·8(10)	94·4(10)	205·0(34)	200·2(34)
15	Green manure and legume in the rotation	105·4 (8)	59·6 (7)	214·0(25)	222·7(26)
16	Green manure and superphosphate (P_2O_5) as in farmyard manure No. 3	..	..	358·5(25)	363·7(26)

Note. Figures in parentheses denote the number of crops raised during the period.

Rotation for plots 1 to 10 and 13 : Maize—*Arhar* ; Maize—Oats
,, ,, plot 11 .. Maize—Barley ; Maize—Oats
,, ,, ,, 12 .. Maize—Barley ; Sann hemp (Green manure)—Oats
,, ,, ,, 14 .. Maize—*Arhar* ; Maize—Oats and Peas (mixture)
,, ,, plots 15 and 16 .. Maize—*Arhar* ; Sann hemp (Green manure)—Oats
(1 maund = 82·3 lb.)

The manures and fertilizers in these trials were always applied every year to the maize crop or to the green manure crop in the alternate years as this replaced maize. After 1930, the fertilizers of Group II (Table II) were applied, half at the *kharif* and half at the *rabi* sowings except in the case of *arhar*, when they were applied in one dose in the *kharif*. In Figs. 1 and 2 are given details of the rotations, the total amount of fertilizer nutrients applied to the various plots and the total yields of all crops obtained during the period indicated.

It will be noted that green manuring with the legume sann hemp in conjunction with superphosphate has given very striking results. The results have moreover been consistently maintained right up-to-date. Since green manure alternated with maize in the *kharif* and superphosphate was applied only to the green manure crop, the plots under this treatment received only half the amount of the superphosphate applied to No. 8, that is, the plot received superphosphate alone in which it was applied to maize every year. The high total yield of the green manure treatment is very striking in view of the facts (1) that it includes only half the number of maize crops and (2) the amount of phosphate fertilizer required for this result is comparatively small. The only other treatment which approaches it is farmyard manure. The value of farmyard manure in crop production is undisputed, but supplies are very limited and agriculture sorely needs a substitute. In these long-term trials superphosphate and green manure have made the nearest approach, though green manure alone has failed badly and superphosphate alone was not as effective as when used in combination with green manure.

TABLE II

Total yields of crops in maunds per acre, 1930-31 *to* 1943-44

Plot No.	Treatments per acre per year	1930-31 to 1943-44 (14 years)	
		'A' Series	'B' Series
	Group I		
1	No manure (check plot No. 1)	139·5(28)	124·0(28)
2	Farmyard manure 4,000 lb.	271·1(28)	255·8(28)
3	Farmyard manure 8,000 lb.	363·8(28)	330·2(28)
4	Farmyard manure 4,000 lb. and rape cake 20 lb. N	364·3(28)	344·6(28)
5	Rape cake 40 lb. N	284·3(28)	254·6(28)
	Group II		
6	Ammonium sulphate 40 lb. N	130·7(28)	118·8(28)
7	Potassium sulphate 50 lb. K_2O	125·1(28)	104·1(28)
8	Superphosphate 80 lb. P_2O_5	237·8(28)	215·7(28)
9	Potassium sulphate 50 lb. K_2O and Super 80 lb. P_2O_5	229·9(28)	220·9(28)
10	Ammonium sulphate 40 lb. N, Super 80 lb. P_2O_5 and potassium sulphate 50 lb. K_2O	280·3(28)	284·0(28)
11	Ammonium sulphate 40 lb. N, and Super 80 lb. P_2O_5	218·8(28)	241·9(28)
13	No manure (check plot No. 2)	102·0(28)	92·9(28)
14	Ammonium sulphate 40 lb. N, and potassium sulphate 50 lb. K_2O	107·9(28)	108·8(28)
	Group III		
12	Green manure in a cereal rotation	76·8(14)	67·5(14)
15	Green manure and legume in the rotation	153·5(21)	134·6(21)
16	As in No. 15, but with superphosphate 80 lb. P_2O_5 to green manure	296·3(21)	284·0(21)
17	No legume and no green manure in the rotation	116·5(28)	88·9(28)
18	No manure (check plot No. 3)	120·5(28)	113·3(28)

Note. Figures in parentheses denote the number of crops raised during the period.

Rotation for groups I, II and plot 18. .. Maize—Barley; Maize—*Arhar*; Maize—Wheat—Maize—Peas
,, ,, plot 12 .. Sann hemp (Green manure)—Barley; Sann hemp (Green manure)—Wheat
,, ,, plots 15 and 16 .. Maize—Peas; Sann hemp (Green manure)—Barley; Maize—*Arhar*;
.. Sann hemp (Green manure)—Wheat
,, ,, plot 17 .. Maize—Barley; Maize—Wheat
(1 maund = 82·3 lb.)

Nitrogen in available form

When the results are examined from the point of view of nitrogen, it will be seen that yields are proportionate to the amount of nitrogen applied only when this nitrogen is contained in an organic manure, such as farmyard manure or rape cake (Table III). The former has given a higher total yield than the latter when applied on the same nitrogen basis. These manures contain, however, phosphate and potash. In the case of rape cake, the phosphate content is small. The yields from artificials supplying nitrogen, phosphate and potash (No. 10) are less than the same amount of nitrogen applied in the form of organic manure. There is little difference among the artificial fertilizer plots whether treated with nitrogen, phosphate and potash (No. 10), phosphate alone (No. 8), phosphate and potash (No. 9) and nitrogen and phosphate (No. 11) which treatment occurs in the 14-year period only. But nitrogen or potash alone (Nos. 6 and 7) or in combination (No. 14) in the 14-year period are definitely poor even less than the 'no manure' control plot. This would suggest that the responses to the application of phosphate were due to a deficiency of phosphorus in the Pusa soil[4], which contains 0·0008 per cent available P_2O_5. The available P_2O_5 in the Kalianpur (U.P.) soil, as reported by these authors, is 0·3237 per cent.

[4] Harrison, W. H. and Das, S. (1921). The retention of soluble phosphates in calcareous and non-calcareous soils. *Pusa Mem.*, Chem. Series, **5**, 195-236

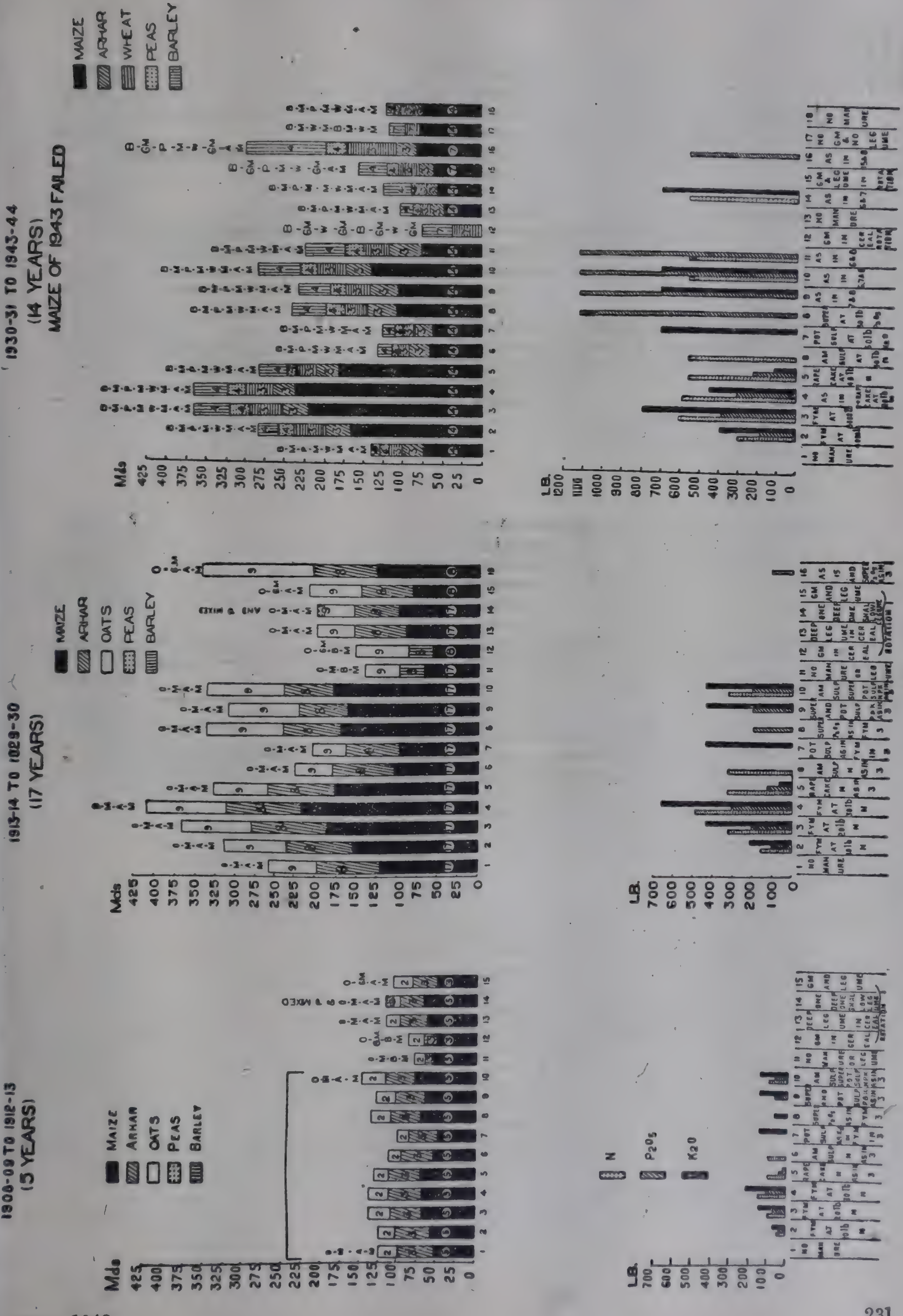

FIG. 1. Total yields of crops and total amounts of fertilizer nutrients in Series A.

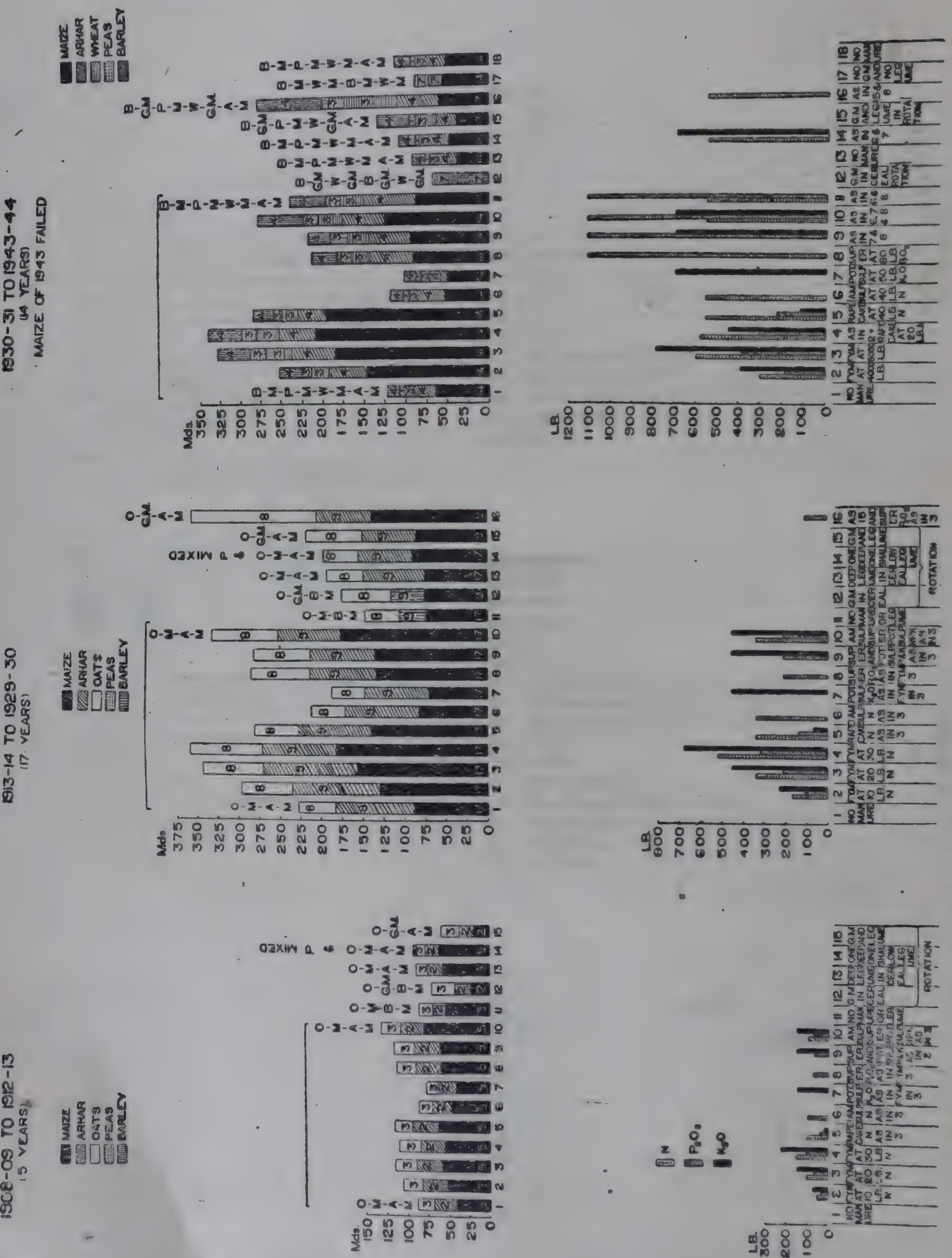

FIG. 2. Total yields of crops and total amounts of fertilizer nutrients in Series B.

TABLE III

Combined yields of 'A' and 'B' Series in maunds per acre

1908-09 to 1929-30 (22 years)			
Plot No.	Treatment per acre	Total yield	Average yield per crop
1	No manure	712·2	8·1
2	Farmyard manure 10 lb. N ..	861·6	9·8
3	Farmyard manure 20 lb. N ..	995·0	11·3
4	Farmyard manure 30 lb. N ..	1034·4	11·8
5	Rape cake 20 lb. N	865·5	9·8
	Fertilizers on the basis of No. 3		
6	Nitrogen	644·3	7·3
7	Potash	578·4	6·6
8	Phosphate	881·6	10·0
9	Phosphate and potash ..	853·9	9·7
10	Nitrogen, phosphate and potash ..	1021·0	11·6
15	Green manure and legume in rotation	601·7	6·8*
16	Green manure and phosphate as in No. 3	722·2	10·8*

1930-31 to 1943-44 (14 years)			
Plot No.	Treatment per acre	Total yield	Average yield per crop
1	No manure	263·5	4·7
2	Farmyard manure 4,000 lb. (20 lb. N)	526·9	9·4
3	Farmyard manure 8,000 lb. (40 lb. N)	694·0	12·4
4	Farmyard manure 4,000 lb. (20 lb. N) + Rape cake 20 lb. N	708·9	12·7
5	Rape cake 40 lb. N ..	538·9	9·6
	Fertilizers		
6	40 lb. N	249·5	4·5
7	50 lb. K_2O	229·2	4·1
8	80 lb. P_2O_5	453·5	8·1
9	80 lb. P_2O_5 + 50 lb. K_2O ..	450·8	8·1
10	40 lb. N + 80 lb. P_2O_5 + 50 lb. K_2O	564·3	10·1
11	40 lb. N + 80 lb. P_2O_5 ..	460·7	8·2
14	40 lb. N + 50 lb. K_2O ..	216·7	3·9
15	Green manure and legume in rotation	288·1	5·1*
16	Green manure and phosphate 80 lb. P_2O_5	580·3	10·4*

* The green manure has been included as a crop to make the averages comparable.

(1 maund = 82·3 lb.)

But when the amount of phosphate contained in rape cake and farmyard manure is examined (which on the basis of 40 lb. nitrogen per acre is 15 and 21 lb. phosphoric acid respectively in Nos. 5 and 3) in relation to the increase in yields, this interpretation is difficult to support. The effects of phosphate (80 lb. phosphoric acid per acre in alternate years) in conjunction with green manure suggest rather that it is the association of organic matter and phosphate which have contributed to the results as the organic matter alone is largely ineffective as is clear from the green manuring alone treatment (No.15).

The behaviour of ammonium sulphate is interesting. Used alone it has throughout depressed the total yield of all crops below that of the 'no manure' control. This consistent result calls for basic research. Ammonium sulphate along with superphosphate and potash have shown considerable increases which clearly indicate the need for phosphorus when nitrogen is applied in a mineral form. In this experiment the responses of the legumes to the treatments containing phosphates are clear. Without added phosphate either in organic or mineral form, however, they make a poor show. Similar responses to phosphate in the case of cereals are not forthcoming. The responses of all crops to green manuring alone is poor, particularly in the purely cereal rotations. The inclusion of a legume in the rotation leads to the addition of some nitrogen to the soil and improves the responses from the green manure. The deep-rooted legume might have the effect of bringing phosphates from the lower level of the soil to the surface soil in the form of crop residues and leaf-fall.

The results of these manurial trials are open to criticism on the grounds that the layout of the trials does not admit of statistical interpretation. There are, however, two series (replicates), A and B, and the results of the two series are practically alike. To remedy this omission, however, a new series was laid down in 1932. Whilst this series provided for the same treatments as given to Plots 1,3,5, 6,7,8,9,10,11 and 14 in the 14-year period, it is to be regretted that no green manure and combinations of green manure and phosphate treatments were included.

In the various appreciations which have been made of these long-term experiments, it is of interest to recall that Harrison[5] in reviewing the results up to 1927-28, drew attention to increased yields of maize and oats following the use of green manure and superphosphate. Again in 1938-39, in reviewing the results of the 1930-38 period, Krishna Iyer[6] drew attention to this effect of the combination of superphosphate with green manure.

As has already been mentioned, this important treatment of phosphate and green manuring was omitted from the new series started in 1932. That this important role of phosphate and legumes, and phosphate and organic matter as green manure should be overlooked can be explained only on the ground of the over-riding importance hitherto given to nitrogen which has tended to obscure the view of the real factors operating.

Effect of rotations

It is of interest to follow the part played by legumes as green manure alone and with phosphate in the various rotations under the different treatments. From Figs. I and II and Table I, it will be seen that during the period 1908-13 and 1913-30 the yield of the 'no manure' plot No. 11 in the rotation in which there was no legume, is only about 64 per cent of the 'no manure' control (No. 1) in which the legume *arhar* was included. The effect of the green manure in No. 12 is a slight increase in yield over and above that of the purely cereal rotation (Plot No. 11), but owing to the loss of half the number of crops of maize when green manure is being grown, the total yield is still less than 'no manure' (Plot No. 1) in which maize and *arhar* take the place of green manure and oats. The introduction of green manure along with the legume *arhar* (No. 15) results in yields higher than Nos. 11 and 12 which were under a purely cereal rotation, but is still lower than No. 1 as one crop of maize has to be sacrificed for green manure once every two years. Further, this treatment gave the same total yield with half the number of maize crops as were included in 'no manure' No. 13, but both are less than 'no manure' No. 1. In this period a new treatment of green manure in combination with phosphate (No.16) was added. With only half the number of maize crops and with phosphate alone at half the dose used in any of the other treatments, except Nos. 2 and 5, both of which it beats, this treatment has given very striking and consistent results surpassed only by farmyard manure Nos. 3 and 4.

It is to be noted that though double the number of maize crops was grown and double the amount of phosphate was used along with considerable quantities of added nitrogen and potash in one case and potash alone in the other, the artificials, phosphate alone, phosphate, potash and nitrogen, phosphate and potash have all given lower yields than half the quantity of phosphate used with green manure.

In the 1930-44 period (14 years) the rotation was changed and the doses of manures and fertilizers were very much increased. Still the results follow the same general trend. The yields of the green manure together with phosphate treatment are exceeded only by farmyard manure every year at 8,000 lb. (No. 3) and farmyard manure at 4,000 lb. plus 20 lb. nitrogen as rape cake (No. 4). Since the phosphate was applied only to the green manure crop grown in alternate years, the amount of phosphate applied is only half the amount of other treatments except in the cases of farmyard manure at 4,000 lb. (No. 2) and rape cake at 40 lb. nitrogen (No. 5) which contain less than half the amount of phosphate of that applied in No. 16. In No. 3 the amount of phosphate is about two-thirds, but in all these cases the organics include nitrogen and potash in considerable quantities. The low amount of phosphate added in rape cake and the comparatively good yields obtained show that phosphate-deficiency of the Pusa soils alone does not explain the good results obtained from the phosphate and green manure treatment (No. 16). In No. 8 phosphate to double the amount of No. 16 was applied and four times the amount contained in the rape cake No. 5, but the yields are inferior to both Nos. 16 and 5. Green manure alone (No. 15), though very inferior to green manure and phosphate, with half the number of maize crops has given better results than the 'no manure' controls Nos. 1 and 18 which, it should be noted, are again better than nitrogen alone (No. 6), potash alone (No. 7) and nitrogen and potash (No. 14).

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[5] Harrison, W. H., (1929). Note on Permanent Experimental Plots at Pusa. *Proc. Board of Agriculture in India*, Subject XII, 5-13

[6] Krishna Iyer, P. V., (1938-39). Review of the Permanent Manurial Experiments at Pusa. *Scientific Reports of the Indian Agricultural Research Institute*, New Delhi, 51-54

Individual crop yields and different treatments

Figs. 3 and 4 show the effects of the treatments on the average yields of individual crops in Series A.

In the case of wheat, barley and oats, the striking effect of green manure and phosphate is evident. The effect of phosphate whether as fertilizer or as organic manure is also apparent in the yields of the pea crop. In the case of maize, of the artificials used, phosphate alone and its combinations with nitrogen and potash are all better than nitrogen or potash alone. Green manure with phosphate surpasses the best artificial fertilizer and is as good as farmyard manure and rape cake, but it must be remembered that we are here concerned with only half the number of crops in the green manure and phosphate treatment. The tendency to declining yields in this experiment is particularly evident in the case of the maize crop, but, it will be noted, that the yield from organics is on the whole much more stable than the best artificial fertilizer mixture. The yields of maize recover in the third period (1931-44) with increased doses of the organics (Nos. 3, 4 and 5) and phosphate and green manure (No. 16), but decline further with all artificials particularly in the case of nitrogen and potash in spite of increased doses.

The average yields of the *arhar* crop are interesting as showing the steadiness of yields from the combined nitrogen, phosphate and potash treatment (No. 10) during the first two periods, and the reversal of the decline in yields that is brought about when the dose of artificials in Nos. 8, 9, 10, 11 is increased. Since neither potash nor nitrogen and potash in combination with phosphate cause much increase in the yields over the phosphate alone treatment, phosphate alone at the increased doses appears to meet most of the requirements of the *arhar* crop in these soils.

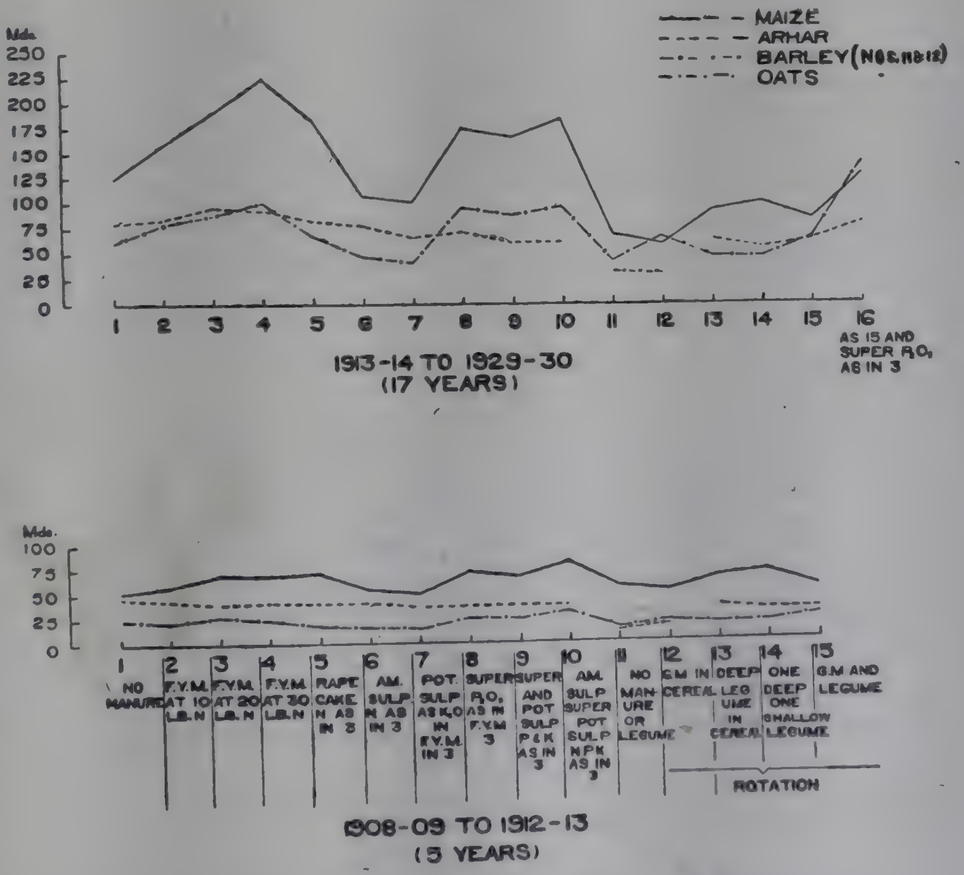

FIG. 3. Individual crop yields (Series A).

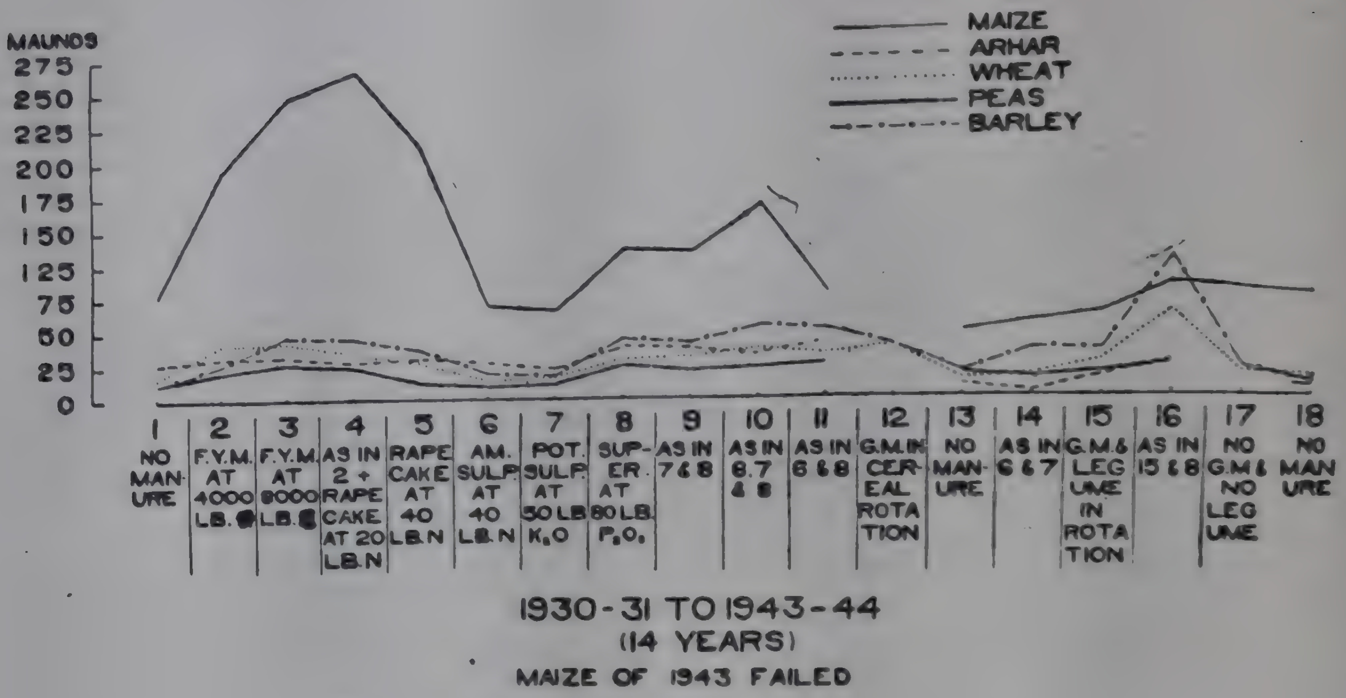

FIG. 4. Individual crop yields (Series A.)

Economics

The economics of manuring for the 17-year period (1913-14 to 1929-30) when low doses of manures and fertilizers were applied and for the 14-year period (1930-41 to 1943-44) when higher doses were employed, can be seen from Figs. 5 and 6. The profit and loss per acre per year due to various treatments and rotations have been calculated by taking the difference between the net value of crops (grain only) after deducting the cost of manures or fertilizers and the value of crops in the 'no manure' control plot. All costs of manures and fertilizers and values of crops have been reckoned at pre-war (1939) rates.

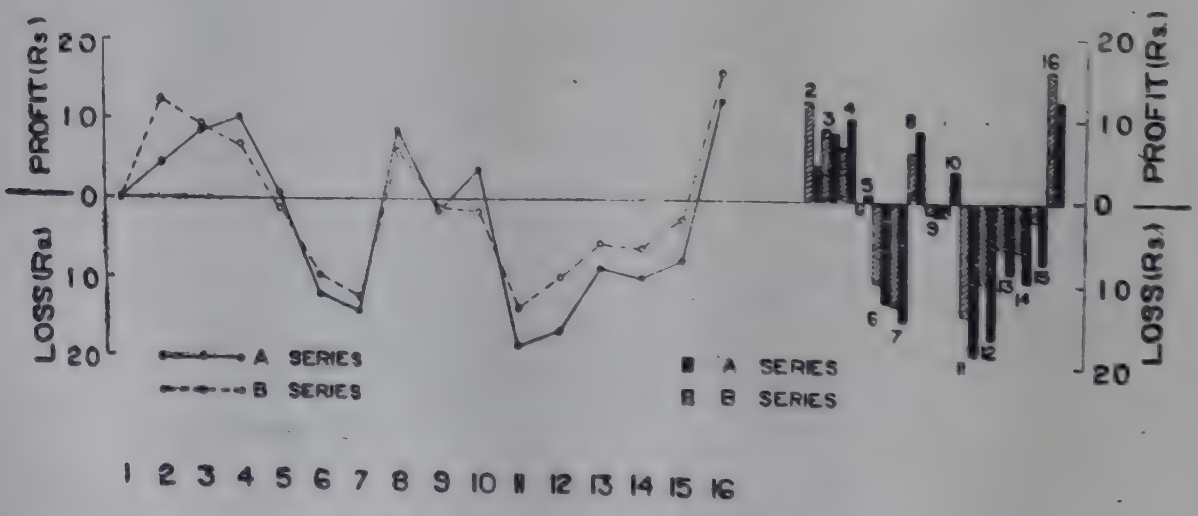

FIG. 5. Profit and loss for the period 1913-14 to 1929-30 (17 years). Average per acre per year. (Series A and B).

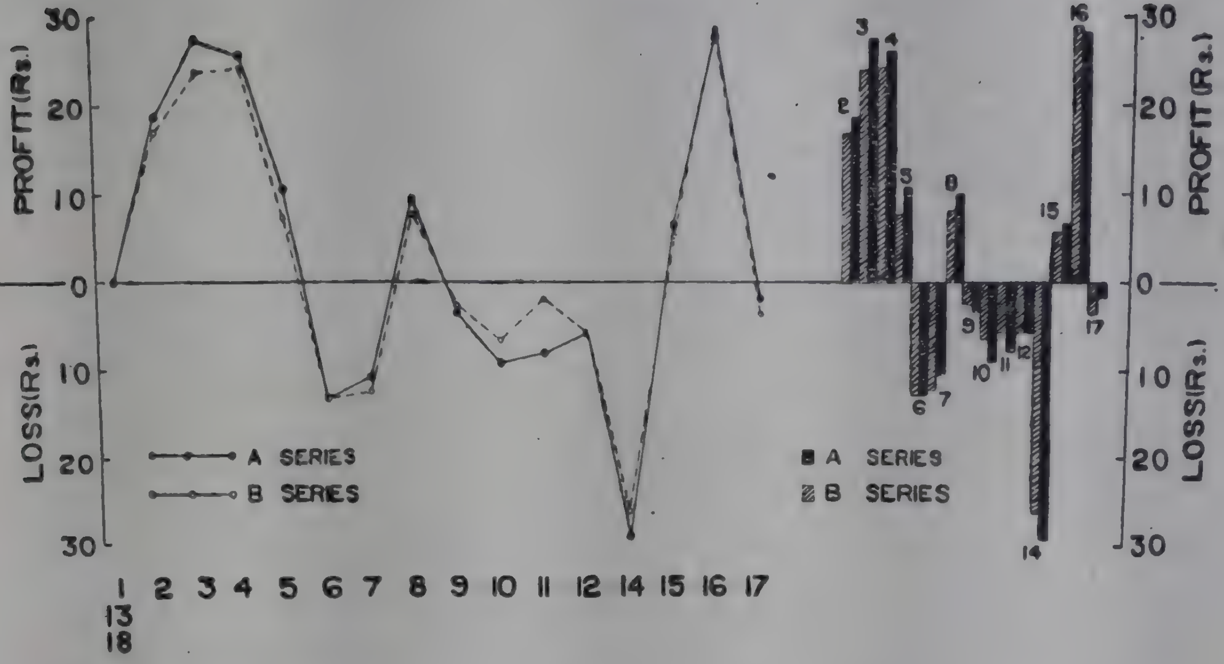

FIG. 6. Profit and loss for the period 1930-31 to 1943-44 (14 years). Average per acre per year. (Series A and B).

In the 17-year period, farmyard manure at different doses (Nos. 2, 3 and 4) has shown profits, so also rape cake (No. 5) in 'A' series, but this has resulted in loss in 'B' series. Of the artificials superphosphate alone (No. 8) in 'A' and 'B' series and complete artificials (No. 10) in 'A' series only have shown profits, the latter being of a lower order than superphosphate alone. The highest profit, however, is shown by the green manure in conjunction with phosphate (No. 16) in both the series.

In the 14-year period, the trend of profit and loss, in general, is the same as in the preceding period, but the magnitude of profit and loss is greater in the latter period owing to the increase in the doses of manures and fertilizers. The maximum profit is again shown by the phosphate in combination with green manure.

The above indicates that phosphate and green manure can replace rape cake effectively and that there is no need in these soils to use edible cakes for manuring the crops indicated.

For this intensity of cropping in the Pusa soil, applications of manures higher than those used in the first two periods are necessary to maintain yields. The importance of phosphate is brought out but this is not solely because these particular soils are deficient in phosphorus. The value of organic matter is also demonstrated and the important role played by organic matter in combination with phosphate is indicated. The results obtained from the organic manures particularly green manuring supplemented with phosphate are in strong contrast with those of the nitrogenous and potash fertilizers used either alone or in combination. In the rotations employed these fertilizers have been of little value unless used in combination with phosphate but when so used the prospect of profit at pre-war (1939) prices has been little. The organic manures alone and phosphate used with green manuring however have given a handsome reward for the money expended.

It would appear that for soils low in phosphate, green manuring is effective only when adequate amounts of phosphates are added. On the other hand, in soils low in organic matter but well-supplied with phosphate, green manures will be effective without the addition of other nutrients, nitrogen and potash.

The compiling of these results has entailed considerable labour and the authors are grateful to Messrs. Sher Singh, Assistant, and

P. M. Kochappa Menon, Post-Graduate Student, for their valuable assistance.

Although the results described in this series of articles, 'I—IV. Phosphate Manuring of Legumes', have indicated possibilities of considerable value to crop production in India, outside the Punjab, little field experimentation has so far been instituted to verify or elaborate these findings. The background of research necessary for interpreting the chemical and biological aspects, however, is now being taken care of by extensive research organized in the Chemistry Division of this Institute by Dr J. N. Mukherjee, Director, who is keenly interested in the possibilities which the technique described appears to offer.

Pouse garmi baishake jarha,
Pratham ashare varbe garha ;
Khana bale sunahe swami,
Sraban bhadore nahiko pani.

If the month of *Pous* (middle of December to middle of January) is unusually hot and the month of *Baisakh* (middle of April to middle of May) is unusually cold, there will be a heavy rainfall in the beginning of *Ashar* (middle of June to middle of July) but there will be scanty rainfall during *Sraban* and *Bhadro* (middle of July to middle of August).—*Agricultural aphorism from Bengal.*

SOME PUBLIC HEALTH ASPECTS OF MILK INDUSTRY IN INDIA

III. MARKET MILK CONTROL

By K. C. SEN and H. LAXMINARAYANA

THE significant part played by the Public Health Departments and other official organizations in fostering the improvement of milk industry has been referred to previously. It would be interesting to make a brief survey of the important legislative measures enacted for the purpose and the various methods by which the production and marketing of milk came to be regulated in the United States, England and other countries.

Market milk control in the United States

Even before the germ theory of disease was proved, the health authorities of some of the larger cities in the United States undertook to control the quality of market milk. Their chief concern at the time was to see that the milk was not deficient in fat and other milk solids, that it was not adulterated, and that preservatives were not used. When the potential dangers from milk not protected from contamination were recognized, a number of cities introduced public health supervision of market milk supply. The State of Massachusetts was perhaps the first to prevent the use of milk from diseased cows and to appoint inspectors for the purpose by a regulation enacted in 1864. A number of other States soon followed this example. In 1896, the Board of Health, New York State, incorporated in its sanitary code, a section prohibiting the sale of milk except under a permit and subject to the rules by the Board.

The first and an important step towards the supply of graded milk was taken in the United States, when the 'Certified Milk' movement was inaugurated by Dr Henry L. Coit of New York in 1893. The aim of this movement was to obtain for infant feeding, a supply of clean, safe, pure and wholesome milk, produced under perfect hygienic conditions and bottled on the farm. A number of stringent rules were formulated for the purpose including the conditions of buildings, management of animals, control of diseases, sterilization of utensils, precautions to be observed in the production and distribution of milk, medical examination of employees, laboratory methods of testing and a long list of strict chemical and bacteriological standards for the milk. A bacterial count of not more than 10,000 per ml. and coliform content of less than 10 per ml. of milk at the time of delivery to the customers were prescribed. The minimum standard fixed for specific gravity and total solids were 1·029 and 12 per cent. As regards fat, an average of 4·0±0·2 per cent was allowed while a minimum of 3·5 per cent for individual samples was laid down. Only such milk as was produced under the above conditions and satisfied all other requirements could be sold under the label of 'Certified Milk'. Medical Milk Commissions were formed to supervise the activities and certify the quality of milk. The movement spread from State to State and in 1907, all the local Milk Commissions functioning in different parts of the country were organized into the American Association of Medical Milk Commissions which had for its objects, the adoption of uniform methods and standards for the production of certified milk and further extension of the movement. The methods and standards were revised from year to year at the annual conventions of the Association in accordance with advancing scientific knowledge. When the demand for pasteurization of milk increased in the country, the Association included the permissive pasteurization (heating to 142° to 145° F. for 30 minutes and quickly cooling to 50°F. or less) of certified milk. All the requirements of certified raw milk had to be satisfied before pasteurization and the processed milk had to

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show a bacterial content of not more than 500 organisms per ml. and less than one coliform organism per ml. at the time of delivery. In course of time, other certified milk products like 'vitamin D certified milk', 'soft curd certified milk', 'certified milk homogenized' and 'certified milk modified', were also included in the scheme with standards specified for each. The measures laid down to ensure the production of certified milk were expensive to carry out and the resulting product commanded a price considerably above the reach of all but comparatively wealthy consumers. It has, however, been a great educational factor in raising the quality of milk production in the United States and the standards for this type of milk are included in the United States Public Health Service Milk Ordinance and incorporated into regulations pertaining to milk supply of many States and municipalities.

The United States Department of Agriculture and various State Agricultural Colleges undertook to carry out research on problems of quality improvement and disseminate information among the producers and manufacturers. The California State Department of Agriculture was one of the first to successfully adopt a State-wide programme of improvement of the dairy industry. In this task, the producers and manufacturers closely cooperated with the authorities and helped to bring about improvement in the quantity and quality of milk produced and in their own economic position.

Milk supervision: Rapid progress in milk supervision began after 1906. By 1914, 77 cities of the United States had adopted ordinances to provide for the sampling and testing of market milk and the inspection of dairies. All cows supplying market milk had to be tested for tuberculosis and reactors removed. In some cities, the animals had also to pass the blood test for Bang's disease. In 1917, the Federal Government in cooperation with the States undertook to eradicate bovine tuberculosis by the 'Accredited Herd' plan. The programme was carried out in a most comprehensive manner with the result that by 1930, over 27 million cattle came under official supervision and within another 10 years, the incidence of bovine tuberculosis was reduced to negligible proportions. The elimination of contagious abortion was also undertaken early by the veterinarians.

The most outstanding contribution towards the improvement of the milk supply was made by the United States Public Health Service. Since 1923, the organization had been engaged in making field and laboratory studies in milk sanitation. As a result of these studies, it formulated a model milk ordinance (approved by the Federal Security Agency, Bureau of Dairy Industry and United States Department of Agriculture) which was recommended for voluntary adoption by States, counties, districts and municipalities in order to encourage a greater uniformity and a higher level of excellence of milk control practice in the United States. A Public Health Service Sanitation Advisory Board was formed for considering proposals for revision and adopting amendments to the ordinance. The ordinance embraces all aspects pertaining to the hygienic production, processing, transportation and distribution of milk and also handling of certain milk products. It defines the sanitary requirements for the different grades of raw and pasteurized milk, states the minimum frequency of inspection and sampling for grading, requires that the grade be shown on the container label, and permits each community to decide for itself at the time of adoption which grades it will permit on the market. It also provides a choice of two methods of punishing violation, either by permit revocation alone or by degradation and permit revocation both. The bacterial standards prescribed for the grading of milk supplies are as given in Table I.

Milk-shed rating method: In order that residents, travellers and milk-receiving communities may have available means of judging the excellence of enforcement, the Public Health Service developed, as a part of its recommended programme, a milk-shed rating method for the periodic measurement of the control work of municipalities by the State milk control authorities. This rating method uses as a yardstick the grade A pasteurized and grade A raw milk requirements of the recommended ordinance rather than the local standards, in order that ratings of different milk sheds may be comparable with each other, both intrastate and interstate. Most of the States having communities operating under the recommended ordinance make periodic milk sanitation ratings of these communities. In order to encourage these ratings to attain and maintain a high level of enforcement, the Public Health Service has been publishing semi-annually in Public Health Reports a list of communities which have been awarded by the State milk sanitation authority a rating of 90 per cent or more. No community is retained on the list if its rating is more than 2 years old or if a later rating is below 90. The Public Health Service also provides advisory assistance to the States in organizing their milk control programmes and in standardizing their rating work.

TABLE I

Alternative bacterial standards of different grades of milk

(The limits are doubled for cream and omitted for buttermilk and sour cream)

Grade	Log average plate count per c.c. not to exceed	Log average direct microscopic count of clumps per c.c. not to exceed	Log average direct microscopic count of individual organisms per c.c. not to exceed	Arithmetic average reduction time in hours to be not less than	
				Milk, etc.	Cream†
A Consumed raw ..	50,000	50,000	200,000	8	7
B Consumed raw ..	1,000,000	1,000,000	4,000,000	3½	2½
C Consumed raw ..	*	*	*	*	*
A To be pasteurized	200,000	200,000	800,000	6	5
B To be pasteurized	1,000,000	1,000,000	4,000,000	3½	2½
C To be pasteurized ..	*	*	*	*	*
A Pasteurized ..	30,000	..	..	..	..
B Pasteurized ..	50,000	..	..	..	..
C Pasteurized ..	*	..	..	..	..

†No limit

*These arithmetic average reduction time limits represent twice the log average plate count limits corresponding to the figures in the preceding column

Voluntary adoption of the above milk ordinance steadily increased from year to year, until at the present time it is legally effective in communities ranging in population from less than 1,000 to about 3,500,000 and located in 39 States. The remarkable advances made in the production of clean and safe milk in United States since 1923 may be appreciated from the following figures collected from a survey made up to 1936. Of the entire market milk sold in all cities of over 1,000 in the country, 74·7 per cent was pasteurized, 99·4 per cent was from tuberculin-tested herds and 35·2 per cent was from abortion-tested herds. Nearly 33 per cent of the total milk supply was sold as higher grade pasteurized milk, 40 per cent as ungraded and lower grade pasteurized, 15 per cent as high grade raw and 12 per cent as ungraded and lower grade raw milk. In the average city reporting, raw milk showed a plate count of 39,000 per ml. and methylene blue reduction time of over six hours, and pasteurized milk averaged 22,000 while pre-pasteurized raw had a count of 87,000 per ml. A similar improvement had been shown in the matter of manufactured products like butter, cheese, dried milk, evaporated milk and modified milk preparations which have largely contributed to the development of a great export trade.

Two defects: The market milk control position in the United States, however, continued to present two defects. First, there were differences existing from State to State and from city to city as to the legal standards for corresponding grades and the frequency of inspection and sampling. For example, the minimum standards for fat, solids-not-fat and total solids varied from 3·0 to 3·5 per cent, from 8 to 8·50 per cent and 11·0 to 12·0 per cent respectively. The minimum bacterial counts for different grades of raw and pasteurized milk and definitions of pasteurization varied to some extent. Such multiplicity of standards and regulations has greatly interfered with the interstate milk trade and the shipment of milk from areas of high production to areas of low production. Secondly, a number of smaller towns had not adopted any system of market milk control with the result that the incidence of milk-borne diseases in these towns remained high. In recent years, considerable progress has been made in the direction of unification of milk control practice and extension of milk regulations in all parts of the country.

Recent developments: During the war period, the unprecedented demand for milk created critical shortages of milk and milk products in many sections of the United States. As a result, many milk plants were forced to accept low grade supplies from nearby producers or from other States—in some cases uninspected supplies that normally went into cheese, butter, milk powder and evaporated milk. Definite deterioration occurred in the sanitary quality of raw milk for pasteurization throughout the country. Cities which had formerly achieved a rating of 90 per cent or more found themselves losing ground, and surpluses from such area no longer existed. The conditions have now considerably improved, but certain markets still find it necessary to import milk from other States or from other milk sheds in the same State which are either not specified in standard milk ordinance areas or the standards in which do not comply with the requirements of the receiving party. In order to overcome this difficulty the Conference of State and Territorial Health Authorities, which met in March, 1944, requested the Public Health Service to prepare a plan for the certification of interstate milk shippers having different compliance ratings either on the Public Health Service Grade A standard or those based on the State's rating procedure checked by the Public Health Service. After much deliberation, it was finally agreed to issue quarterly lists of shippers with surpluses certified by the State health or supervisory agency as complying with the different standards. But the plan was actually inaugurated in December 1946.

In 1942, the International Association of Milk Sanitarians, which had been doing much work in this field, particularly in the matter of unification of standards for raw milk and standardization of laboratory procedure for milk examination, appointed a Committee on Milk Regulations and Ordinances for the purpose of drafting minimum essential standards that would be acceptable to the entire country. A new set of standards have been proposed which are closely based on those of the Public Health Service Milk Ordinance, and which are expected to be incorporated in a revised edition of the Public Health Service Milk Ordinance. The employment of the revised standards as a basis would simplify the procedure for the certification of interstate milk shippers and facilitate such shipments.

Another recent development that has taken place is the system of reciprocal sanitary milk control among the States recommended by the American Public Health Association in 1946. This Association has contributed much towards the development of milk control in the country and has laid down standard methods of chemical and bacteriological analysis for dairy products, which are widely followed in control laboratories. They have suggested that each State should establish an inspection system to determine the adequacy of local control within the State, and that the Public Health Service should inaugurate a system of certification for interstate shippers with periodic spot checks to determine the acceptability of State inspections and laboratory supervision. It was also recommended that instead of publishing lists of shippers who achieved minimum ratings of 90 per cent and 80 per cent, one list should be published containing all interstate shippers showing their actual ratings. The adoption of this system would enable each community to obtain milk of the highest quality available at the time.

The most characteristic features in the progress of milk control in the United States and which have culminated in raising the status and efficiency of the industry to the highest possible level are first, the constant endeavour to effect further improvements in the conditions of market milk production and manufacture of milk products throughout the country notwithstanding the very high standards already obtained and, secondly, the splendid cooperation and united effort put in by the various federal agencies, State authorities, scientific and professional associations, research institutions, trade organizations, individual dairymen as well as by the general public for attaining this end.

Market milk control in England

Among the countries in Europe, England was one of the first to develop a sound system of grading milk and introduce official quality control programmes. From early days, dating from the Public Health Act of 1875 to the Milk and Dairies (Consolidation) Act of 1915, legislation was mainly confined to the control of milk-borne infections and the general conditions under which milk was produced and distributed. The adulteration of milk by the addition of water or the abstraction of butter-fat was regulated by the Sale of Food and

Drugs Act, 1875, and subsequently by the Sale of Milk Regulations, 1901, which prescribed legal standards for fat (3 per cent) and solids-not-fat (8·5 per cent) in milk. The first serious effort to improve the hygienic quality of milk was made by the British Ministry of Agriculture and Fisheries with its clean milk competitions in 1920. These allowed instructions in clean milk production to be given to a small proportion of producers who raised the standard to very high levels. At the same time, the more progressive dairymen began to encourage the production of milk of good keeping quality and chemical composition by means of additional payments to producers supplying such milk and also the introduction of contract conditions aiming at good quality milk. The initial outcome of these developments was the promulgation of the Milk (Special Designation) Order, 1922, with amending Orders in 1923 and 1936 under which the Ministry of Health granted powers to local authorities to issue licences for the production and distribution of good quality milk under the following official grades.

TABLE II

Official grades of milk

Grade	Bacteriological standard		Other conditions
	Plate count per ml.	Coliform content	
1. Certified milk ..	30,000	Absent in 1/10th ml.	Animals to be tuberculin-tested every six months and suspected animals removed Milk to be bottled on the farm
2. Grade A (Tuberculin-tested)	200,000	Absent in 1/100th ml.	—Do.— but no bottling of milk
3. Grade A ..	200,000	Absent in 1/100th ml.	Veterinary examination every three months and tuberculin-positive animals to be removed.
4. Grade A (pasteurized by Holding Method)	30,000	Absent in 1/10th ml.	—Do.—
5. Pasteurized by Holding Method	100,000		

Milk Marketing Board: Regulations were also made for official inspection of the premises and the methods of milk production and handling and for bacteriological examination of milk supplies. Since the movement was purely voluntary and the production of graded milk was expensive, it made relatively slow progress during the first ten years, mainly among producer-retailers and on farms situated near large population centres. As a result, the measure catered only for a specialized market and the majority of the ordinary producers were left without any hygienic control and continued to produce ungraded milk. This factor as well as the realization that the system of grading raw milks on the basis of plate counts was not satisfactory, led to the introduction of the 'Accredited' scheme in 1937. According to this, all milks not reducing methylene blue within 5½ hours in winter and 4½ hours in summer were placed in the 'Accredited Standard'. At the same time, the Milk Marketing Board of England and Wales arranged that all producers of Accredited Milk would be paid 1d. a gallon extra for their milk irrespective of the retail price at which it was sold. This increased remuneration stimulated a large number of farmers to produce 'Accredited Milk' and by October 1936, over one-third of the total supply of milk in England and Wales fell into this category. The Milk Marketing Board was further concerned with the economic aspects of the trade, coordination between the producers, distributors and consumers and the efficient transport and distribution of milk supply. Eventually the Milk Maketing Board was empowered to purchase all large scale supplies and make arrangements for their distribution.

Eradication of diseases: Progress was also made in the control and eradication of disease in dairy herds with the Ministry of Agriculture assuming responsibility for the routine inspection of dairy herds under the Milk (Special

Designations) Order, 1923 and Tuberculin Order, 1925, and the introduction of schemes for voluntary control of those cattle diseases which affect milk supply, notably the 'Attested Herds' scheme for eradication of tuberculosis, in cooperation with National Veterinary Medical Association and the National Farmers Union. As a consequence the general quality of milk production in the country improved considerably. The number of designated milk producers rose from slightly over 500 in 1927 to 32,000 in 1944 with a further 5,600 attested herds under the Ministry of Agriculture's 'Attested Herds' scheme, many of which are potential graded milk producers.

As a result of the Second World War, the general keeping quality of market milk deteriorated, particularly in the more remote areas from which milk was bulked and despatched for human consumption to distant industrial centres, and large quantities of milk were lost due to souring. In order to safeguard the milk supply, the Ministry of Agriculture introduced in June 1942, the National Milk Testing and Advisory Scheme in coopreation with the Ministries of Health and Food, the Milk Marketing Board, the Milk Distributive Trade and the National Farmers Union. Briefly, the scheme involved the testing of milk supplies received from individual producers at the point of first delivery. The larger units (i.e. depots, creameries or dairies which received milk from at least 100 producers or handled at least 2,000 gallons of milk a day) had to provide their own laboratories and testing staff and carry out the standard test under the general supervision of the Advisory Bacteriologists constituted for the purpose. In the case of smaller units or producer-retailers supplying milk direct to the consumers, the Advisory Bacteriologists had to make arrangements to sample and test the milk. The milk supplies of all producers, including designated milk, were subjected to a fortnightly examination by means of the newly introduced resazurin test and graded according to the following scale :

Grade	Standard to be attained
—	(Resazurin colour disc reading after incubation of test samples at 37°C. for specified periods according to atmospheric temperature)
Category A (good keeping quality)	6 to 4 (blue to mauve)
Category B (moderate keeping quality)	3½ to 1 (beyond mauve up to pink)
Category C (poor keeping quality)	½ to 0 (fading pink to colourless)

In addition, each producer's milk, on arrival at the collecting centre or creamery, was inspected by the platform examiner and any milk which was suspected to be of doubtful quality, was subjected to the rapid (ten minutes) resazurin test and was accepted for bulking if the resazurin reduction at the end of 10 minutes was not lower than disc 4 (mauve). Samples showing disc numbers ½ to 0 were returned as unsatisfactory while those recording disc numbers 3½ to 1, were considered to be of doubtful quality and attempts were made to salvage them if possible or utilize them in some other manner.

From the results of the tests and subsequent investigations, the reasons for the poor keeping quality were determined. Where the farmer's methods of production were at fault, visits were made to the farm by experienced advisory officers with a view to remove the causes of poor keeping quality. If the transport arrangements were faulty, remedial action was a matter for consideration by the Milk Marketing Board. To safeguard the keeping quality of the milk and to prevent souring due to dirty churns, etc. the scheme provided for churn testing and advisory work at depots, creameries and dairies. Particulars of persistently unsatisfactory producers or dairies or cases of designated milks failing to reach the prescribed standard were sent to appropriate licensing and sanitary authorities for suitable action. The working of this scheme for over four years since its introduction has resulted in a great improvement of the milk position. More than 92 per cent of wholesale producers and about 31 per cent of the producer-retailers are now within the scheme. It has enabled county advisory work to be concentrated on those farms where it is most required and has reduced to a minimum the losses from souring during the hot weather. One of the greatest benefits arising from this scheme has been the preparation and issue of standard techniques for use in the laboratory control of methods of milk production, handling and distribution.

Milk trade in other countries of Europe

In other countries of Europe, the method of controlling market milk is somewhat different from that in the United States, Canada and England. In Scandinavian countries, milk for children is produced on farms that are under veterinary and sometimes medical supervision. Sweden and Denmark attained a high standard in the methods of milk production, very early in the history of dairying, although they specialized more in the direction of manufacturing milk products rather than of liquid milk marketing. The main factor responsible for this improvement has been the organization of the industry on sound cooperative principles. As early as 1882, the first cooperative creamery was established by a few poor peasants in Jutland (Denmark) and the principles laid down in the by-laws of this society proved to be the foundation on which the whole cooperative movement in dairy industry has been built. By 1939, there were more than 1,400 local dairy societies throughout Denmark, each of which owned and operated a creamery through a board of directors. As members of the societies and owners of the creameries, the farmers became interested in producing the very best quality of milk and milk products. The local societies organized district associations which in turn were united into provincial unions and finally into the National Dairy Association. The latter body concerned itself with important matters of general interest to the dairy industry such as legislation, Government regulations, transport facilities, export, etc. All these organizations were mainly interested in the management of the creameries and the technical improvement of the products. In course of time, Cooperative Export Societies for looking after the export trade of the industry and Cooperative Purchasing Organizations for providing cheap feeding stuffs and other materials required by the farmers came into existence. By friendly cooperation between the Government, the producers and the exporters, rather than by coercive regulations, an effective control has been set up which has helped to maintain perfect sanitary conditions in the production and utilization of milk, eradicate cattle diseases to a great extent and give the Danish dairy products a leading place on the world market. The control is carried out by officials of the Ministry of Agriculture and deals with the health conditions, grading and stamping of the export products. The interests of the producers, workers and consumers are also amply protected by compulsory insurance schemes covering all sorts of risks including the health of livestock. In Sweden, the first cooperative dairy was established in 1880 and the movement rapidly became popular embracing all aspects of the industry as in Denmark. In France also, pasteurization of all milk was insisted upon except certain specified milks produced under rigorous conditions to be sold under the designation 'non-pasteurized' milk. Two grades of pasteurized milk were recognized, namely, (i) 'milk' which had to be free from pathogenic bacteria and contain not more than 100,000 bacteria per ml. and (ii) 'certified pasteurized milk' which had to be free from pathogens, contain less than 30,000 bacteria per ml. and no coliforms in one ml. and had to be bottled, held at a temperature not above 12° C, and sold within two days after pasteurization. In all cases the pasteurizing plants had to be periodically inspected and certified for their efficiency.

Among the eastern countries, considerable headway has been made in Australia, New Zealand and Japan in the regulation of milk marketing. It is interesting to note that in Japan the incidence of tuberculosis from bovine origin is said to be rare. The developments taking place in Australia, where extreme tropical conditions prevail in certain parts, should be of particular interest to India. Some of the bacteriological standards fixed for grading milk supplies have been moderated to suit local conditions (e.g. methylene blue reduction time of three hours is allowed for superior grades of milk), although the methods of control have been shaped after the old western standards. The position in India will be reviewed in the next paper.

THE MILK-TREE OR THE COW-TREE (*BROSIMUM GALACTODENDRON*) OF THE CARACAS, VENEZUELA

By I. A. SAYED

QUITE a host of the tropical plants generally present striking characteristics in respect of splendour of growth and bloom or economic utility. The usefulness of these plants, sooner or later, became known to the civilized man who undertook their systematic culture for his benefit. Numerous names of the tropical plants could be cited which now form an integral part of either an article of food or a commodity of commerce. The cow-tree, the subject of this paper, is an example to the point.

Historical

The credit of first discovering the milk-tree goes to M. de Humboldt, the celebrated traveller. However, according to Rivero[1], it was one Lact by name who was reported to have made known in Europe the astonishing species which yields milk analogous to the milk of the cow and hence the name cow-tree. Reporting on the milk of the cow-tree, Humboldt obviously felt astonished at the assertion by the natives who drink large quantities of the milk of its being highly nutritious, as almost all the lactescent vegetable juices are acrid, bitter, and more or less poisonous. His experience at Barbula, the home of the milk-tree, however, proved that the virtues of the milk were not exaggerated. In their natural habitat, he found the trees thriving under the most rigorous conditions along the rocky hill slopes with leaves and branches appearing dry and dead but upon an incision being made into the bark as far as the wood, an abundant quantity of sweet and nutritious milk gushed forth. Humboldt himself drank a large quantity of it, both at night before going to bed and in the morning, without experiencing the slightest uncomfortable effect.

Out of the few seeds sent by Lact from Venezuela to Europe for rearing the trees, a few were forwarded to Bombay[2], India, in 1880. But available reports indicate that the young plants raised from them perished due to conditions being unsuitable.

Geographical distribution

The milk-tree or the cow-tree was first discovered in the forests of Barbula near Naguangua[3]. The tree is believed to be indigenous to the Cordillera shore from Barbula to the Maracaibo lake[4] and to the hot and temperate regions of Venezuela and seem to attain perfection in areas where the soil is rich and weather damp or wet all the year round. Species of *Brosimum* and *Brosimum galactodendron* occur in Panama along the Blas coast and on the hills bordering the San Juan River on the Costa Rican side. The milk-trees are known to exist on the mountain forests about Cariaco and parts of the sea coast of Venezuela[5] and also found in the region between Cape Codera and Barcelona[6].

Botanical description

Soon after the discovery of the milk-tree, the scientific name assigned to it was *Brosimum utile* (Moraceae) but later, after close botanical study, the specific name *galactodendron* was substituted for *utile*. However, the milk-tree is variously referred to as *Brosimum utile*, *Galactodendron utile* or *Brosimum galactodendron*, the latter terminology being generally accepted. The cow-tree or the milk-tree,

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[1] Rivero, Mariano de, and Boussingault, M. (1825). Memoirs on the milk of the cow-tree. *Edinburgh Philosophical J.*, **12**, 97-102

[2] Precis of the report on the results of the cultivation in the Bombay Presidency of the cow-tree. *Indian Forester*, 1883, **9**, 517-518

[3] Pittier, H. (1926). *Manual de las Plants Usuales de Venezuela*, Caracas, Venezuela Litografia del Comerico

[4] Galactodendron utile salode vaca or cow-tree of the Caracas, *Botanical Magazine*, 1840, **66**, 3723-3724

[5] Jackson, J. R. (1873) The cow-tree. *Pharmaceutical J. Series*, **3**, 321-322

[6] Lockhart, D. (1827). Observations on the cow-tree of the Caracas. *Edinburgh New Philosophical J.*, **3**, 335-336

which bears a general resemblance to the star-apple tree (*Chrysophyllum cainito*), generally attains height of 80 to 100 ft. from the roots to the first branch and a diameter of 7 ft. which, in well-grown old trees measures, about 5 ft. above the ground, 20 ft. The branches extend fully 25 to 30 ft. from the trunk and are clothed with luxuriant foliage. The foliar region occupies an additional height of 40 ft. Leaves, arranged on the branch alternately, are 10 to 16 in. long and 2 to 3 in. wide, and are pointed, coriaceous, green above and golden brown beneath and are marked with parallel veins projecting beneath. The globular flower receptacle produced in the leaf axils consists of a solitary female flower and many male flowers. Fruits are depressed, globose, 2 to 2·5 cm. in diameter, fleshy and yellow at maturity and filled with a single almond-like seed. The wood of the tree is white, hard, and well-grained.

Characteristics of the vegetable milk

A spiral incision made into the bark of the milk-tree yields a profuse flow of gluey, thick milk devoid of acridity and with a very agreeable balsamic flavour. Unlike most lactiferous plants, the milk of which solidify on exposure, a characteristic typical of the rubber latex, the milk of the cow-tree retains its fluidity. The milk is used by the original inhabitants of Venezuela as an essential article of food and as a substitute for the common milk. The vegetable milk, however, is viscid in consistency and, on standing, quickly assumes yellow colour, gradually transforming into cheesy consistency[7].

The viscidity of the milk renders it rather unpleasant to those not accustomed to it. It is reported[8] that though this milk of aromatic odour is sweet, it leaves a clamminess on the lips and a slight bitter taste on the tongue. This view may be accepted with caution as many travellers, including Humboldt, who often drank this milk have said much in praise of its quality.

The flow of milk is most abundant at dawn. It is a little thicker and mixes readily with water. It does not coagulate on boiling but a thick yellow pellicle, similar to the cream, is formed on the surface.

Uses of the milk and the bark of the tree

The original inhabitants of Venezuela either drank the milk as such or used it with bread made of corn or cassava (*Manihot utilissima*). They also skilfully utilize the bark of the cow-tree for making fabrics which make their wearing apparel.

Apart from its food value, the vegetable milk is commonly employed medicinally for curing asthma.

Composition of the milk

The available literature does not indicate complete agreement as to the constituents of the milk nor is there consensus of opinion with regard to its properties and food value. The constituents of the vegetable milk as determined by different investigators are given in Table I.

TABLE I

The constituents of the vegetable milk as determined by different chemists

1. Boussingault and Rivero[1]	2. Solly[1]	3. Marchand[1]
Water	Water	Water
Wax	Resinous waxy material	Fermentable sugar
A substance similar to animal fibrin	Saline substances : magnesium acetate	Lime
Sugar	Glutin	Magnesium tied up with phosphoric acid
Magnesium salt	Albumin	Traces of acetic and butyric acid

4. Heinz[1]		5. Jackson[5]		6. Boussingault[8]	
	Percentage		Percentage		Percentage
Water	57·3	Galactin	30	Wax, fatty material	84·10
Vegetable albumin	0·4	Acetic acid	..	Reducing sugar	2·00
Waxy material	5·8	Specific gravity	1·01212	Invertible sugar	1·40
Resinous material	31·4			Gum, easily saponifiable	3·15
Gum and sugar	4·7			Casein albumin	4·00
Fixed salts	0·4			Alkaline-ash-phosphate	1·10
				Non-nitrogenous substances	4·25

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[7] The Cow-tree. *Encyclopaedia Brittanica*, 1929

[8] Boussingault, M. (1878). Surla Composition du Lait B'arbre de la Vache. *Academie des Sciences*, **87**, 277-281

Boussingault carried out the chemical analysis (Table I) in 1878. On the basis of his analysis, he opined that the vegetable milk approaches, in its general constitution, the cow's milk in as much as it contains a fatty substance, sugary material, albumin, and phosphates. The milk contains 42 per cent total solids, an amount three times greater than that contained in the cow's milk and, therefore, it would be appropriate to compare the composition of the milk possessing a natural creamy consistency with that of the common cream the composition of which, as reported by Jeannier ^{8} is as follows :

Butterfat ..	34·3	Per cent
Milk sugar ..	4·0	,,
Casein and phosphate ..	3·5	,,
Total solids ..	41·8	,,

It is, therefore, clear that the total solid contents of the vegetable milk are almost equal to that of the cream.

Verdoorn[9] reported that the milk of the cow-tree contains little or no resin or rubber and could be used as a substitute for milk. Record and Hess[10] believed the milk to be harmless if taken in small quantities but considered that it could be better employed for conversion into chewing gum. Boussingault and Rivero[1] have reported that by heating the milk, but not boiling, a greasy matter which had the appearance of refined wax of Spain could be separated.

Conclusion

It may be pointed out that the vegetable milk of the cow-tree is at present just a curiosity but its potential value as a suitable substitute for the common milk cannot be discounted. To the large section of the world's undernourished population to whom good, pure cow's milk is rarely or inadequately available, this nutritive vegetable milk should prove to be a great boon. In view of the proved nutritive value of the milk and its possible future importance as an article of food, people engaged in the agricultural research may undertake a comprehensive study of the cow-tree from all aspects.

IN spite of the absence of manuring deep ploughing in hot weather increases the yield at least by one-fourth.—*Agricultural aphorism from the United Provinces.*

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[9] Verdoorn, F. (1945). *Plant and Plant Science in Latin America*

[10] Record, S. J., and Hess, R. W. (1943). *Timbers of the New World*

WEED CONTROL

By CLIFFORD C. TAYLOR

IN India, as indeed everywhere, the millions of people who grow food and fiber crops must contend with the perpetual problem of weed control. If India is to be able to feed its 350 million people satisfactorily, the weeds which rob fertility and moisture from the food crops must be controlled. It is just as important to save the available fertility and moisture in the soil for proper use as to bring additional fertilizer and water to the village lands. Indeed, it is *only* by destroying the soil robbers that more food can be produced at once because it will take years of time and large investments of money to provide as much fertility and water as the weeds are stealing each year. The millions of cultivators of the land, given proper guidance and inspiration, can do more than the captains of industry, important as they are, to increase the food supply for themselves and others.

Methods of weed control

In the United States many methods are used in combination to control weeds.

Before planting a close-planted crop like wheat, which cannot be cultivated during the growing season, the easiest way of eliminating most of the weeds is to grow a row crop which can be cultivated between the rows by the use of proper farm implements.

In the low-rainfall areas where it is necessary to accumulate moisture in the soil before planting a crop the land is left unplanted (fallow) for a season and the weeds which appear are killed by the use of proper farm implements every time they start to grow.

Before seed is planted, any weed seed in it is fanned out, screened out or picked out so that no weed seeds are planted. The sale of seed containing bad weed seeds is prohibited by law.

During the growing season any weeds that appear in the field are ploughed out, chopped out or pulled out. In India the weeds can be used for cattle fodder, even though it is not the best of fodder.

In the California rice fields many weeds are killed by regulating the depth of the water on the rice so as to drown the weeds.

Recently American farmers have begun to use chemicals as a dust or spray to kill weeds in fields of grain or flax. The chemical 2, 4-D has proved successful as a killer of wild mustard, Russian thistle and certain broad-leafed weeds. There are various types of the 2, 4-D chemical (sodium salt, amine and ester). One of the commercially sold chemicals for killing weeds which appear before the crop appears above ground contains dinitro-o-sec-butylphenol in Diesel oil and is applied at the rate of one gallon per acre in 30 to 35 gallons of water. The proportion of Diesel oil and the amount used per acre are varied according to the crop being sprayed. The concentration of the chemical must be lower for some crops, such as flax, to avoid injury to the crops. This new discovery was the main topic discussed at the North Central States Weed Control Conference, held at Topeka, Kansas on December 10-12, 1947. The conference was attended by 600 delegates from 35 American States and 5 Canadian provinces. In India these chemical methods of weed control would require professional direction.

Canada is also starting to use 2, 4-D for controlling weeds on the vast wheat growing plains of the Prairie Provinces. This year between 15,000 and 20,000 machines are applying 2, 4-D as a spray or dust to over 5,000,000 acres of grain. The chemical is applied either before the crop appears above the ground or when the crop is four inches to six inches high. The weeds at that stage are far more susceptible to the chemical and a lighter rate of application is sufficient.

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REPORT ON GERMINATION TESTS OF SAMPLES OF WHEAT FROM RUST-AFFECTED FIELDS

NINETY samples of wheat were received from the Deputy Director of Agriculture (Crop Research), Bombay Province, Poona.

The samples were graded with respect to their appearance; those which were almost normal in plumpness of grain, etc. were given Grade I, those which consisted of grains very much shrivelled were classified as Grade III and those which were intermediate were allotted Grade II.

The samples were divided into six lots each. The germination tests of three of the lots from each of the 90 samples have been completed and this report presents the results obtained. There were two treatments, one with Agrosan G.N. and the other without. The chemical was applied to the seeds by gently shaking the seeds with a small quantity of Agrosan G.N. powder in a test tube so that each seed had a thin coating of the chemical.

Germination tests were conducted in enamel dishes with pieces of moist blotting paper placed over a thin layer of cotton. The dishes were kept in germination chambers in a cool place in the laboratory where the temperature ranged beteween 70° F. and 80° F.

It was observed that Agrosan delayed germination by one or two days and thereafter germination was erratic. In some samples, short and thick radicles were produced which did not grow any further. The untreated seeds, irrespective of grade, germinated uniformly. In the series treated with Agrosan, there was comparatively less fungus attack than in the untreated series.

The results of the germination tests are summarized in Table I.

TABLE I

Summary of results of germination tests

Grade	No. of samples	Germination percentage Average of untreated seeds	Average of treated seeds
I	16	81	70
II	30	80	76
III	44	68	55

There were four samples in Grade I which showed considerable fall in germination when treated. Three samples in Grade II also exhibited this peculiarity. The results with these samples are tabulated in Table II as they appear to be worthy of special notice.

TABLE II

Germination of seven peculiar samples

Sample No.	Grade	Germination untreated	percentage treated
3	I	83	11
49	II	55	23
52	I	44	13
53	I	76	53
58	II	89	15
60	II	79	33
88	I	87	9
	Average	73	22

It was observed that these samples had an oily surface with the result that much more of the Agrosan powder adhered on to the seed coats as shown by a distinct change in their colour. The excessive adherence of this powder may have been responsible for the low germination of these samples when treated. If these samples are omitted from calculation, Table I would read as follows:

TABLE III

Summary of results of germination tests after omitting the seven disputed samples

Grade	No. of samples	Germination percentage Average of untreated seeds	Average of treated seeds
I	12	85	86
II	27	80	82
III	44	68	55

From Table III, it would appear that the germination was not affected adversely by treatment with Agrosan in the case of samples falling in Grade I and II; but the samples classified in Grade III showed a lower germination when treated with Agrosan.

The seedlings of both treated and untreated samples were transplanted in well prepared seed beds (and not in pots), and growth of these seedlings was observed for 15 days. Table IV summarizes the results of these tests.

The differences in the survival percentage of the treated and untreated samples in the three grades do not appear to be of any statistical significance.

In conclusion it must be mentioned that a sample of Pusa-4 wheat which was free from rust was used as a control. This sample showed a germination of 98 per cent and 99 per cent of untreated and treated seeds respectively and a survival percentage of 86 per cent and 97 per cent of untreated and treated seeds respectively.

TABLE IV
Summary of results of survival tests

Grade	No of samples	Survival percentage	
		Untreated seeds	Treated seeds
I	16	80	79
II	30	83	84
III	44	72	76

U.S. BURLAP TRADE SERIOUSLY DISTURBED

IN the United States there is an increasing use of paper bags where burlap was used before, reports the *Jute Bulletin* of April 1948, released recently by the Indian Central Jute Committee. The burlap yardage lost by this substitution is growing in volume each year, and it is a matter of grave concern throughout the trade. Some of the products, which were formerly packaged only in burlap bags, are gradually being taken over by paper containers. Cement was formerly packed entirely in burlap bags and it is now packaged nearly 100 per cent in paper containers in the United States. A similar situation applies to fertilizer, refined sugar and several other commodities.

According to a recent report it is estimated that in the year 1940 in the United States approximately 58,000,000 yards of burlap was used for the manufacture of bags for fertilizer and approximately 49,000,000 yards for the manufacture of bags for refined sugar. It appears, that high prices for burlap are gradually slowing down consumption in areas where cheaper paper bags can be used as a substitute.—*I.C.J.C. Press Note.*

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. What are the economic losses due to rinderpest in India and how it may be controlled?

A. Rinderpest is the deadliest of all contagious diseases in this country and is responsible for the death of the largest number of cattle from any disease. From the figures available it is estimated that annual mortality traceable to this cause in the Indian Union is more than 1·5 lacs bovines which are worth more than three crores of rupees. The animals which survive an attack of this disease are left in a very debilitated condition and thus lag behind in work and milk production. Loss due to this disease in milk production is estimated to be about 17 lakh maunds, which should be worth more than 17 crores of rupees. The total loss is not 4·7 crores of rupees only as the country also suffers because of the loss in working hours of bullocks because of their low condition resulting from this disease and thus the agricultural production is to a great extent adversely affected. These colossal figures of loss speak for themselves and point to the urgent necessity of initiating a coordinated and sustained effort to stamp out the disease altogether.

It is now known that there is no specific treatment for this disease and consequently we have to concentrate all of our efforts in adopting control and preventive measures. After trials with various methods of vaccination we now know that vaccination with goat tissue virus is the safest, cheapest and the most efficient method for dealing with rinderpest in India. This vaccine confers solid immunity lasting for about 5 to 6 years. At present the control of rinderpest is entirely in the hands of various provinces and States and available figures show that only about 2·2 per cent of the entire population is vaccinated annually. The vaccination is usually undertaken at the site of an outbreak. For complete eradication of the disease the only effective method is the mass immunization of cattle. This work should be undertaken jointly by the provinces, States and private individuals interested in the welfare of cattle in this country. For satisfactory completion of the work it is essential to enact suitable legislation to enforce compulsory inoculation. It has been estimated that for mass immunization with goat-tissue-virus vaccine the cost would come to only about one anna per animal. All the animals in the entire country can be immunized in about seven to eight years' time if the work is undertaken by all the provinces and States simultaneously. The total cost for running such a scheme on an All-India basis is estimated to be about Rs. 160 lacs. Another important factor to be borne in mind before beginning the work on mass immunization is that proper measures should be taken to prevent the ingress of the disease from across the border. As compared to the annual loss of Rs. 4·7 crores caused by this disease an expenditure of Rs. 160 lacs is negligible. Mass immunization can be made more effective by providing mobile units for inoculation.

Before the ideal of mass immunization can be transalated into practice some of the undermentioned precautions will be useful in controlling the disease to a great extent :

(a) Efforts should be made to detect the disease as early as possible.

(b) Movement of cattle should be controlled by the establishment of quarantine stations at suitable places.

(c) Legal powers for compulsory vaccination in areas threatened with an outbreak of rinderpest should be provided.

(d) Transport of infected bones and skins should be banned.

(e) Provinces and States should increase the number of routine vaccinations as much as possible.

As we know, the virus eliminated from the body of the infected animal through nasal discharge, urine and faeces is more infective than that obtained directly from the diseased issue. This means that the contaminated excreta are more dangerous for the spread of the disease than actual contact. This should be kept in view in adopting preventive measures.

What we need therefore is a vigorous campaign to fight the disease by immunization and propaganda. (Animal Health Service of the I.C.A.R.)

F.A.O. REGIONAL OFFICE IN EAST ASIA

THE Food and Agriculture Organization proposes to set up a regional office in East Asia shortly to coordinate and stimulate work on nutrition and to develop rice and rice diets.

This disclosure was made recently by Dr W. R. Ackroyd of F.A.O., in a paper on 'Malnutrition and the Rice Problem' presented to the fourth International Congress on Tropical Medicine and Malaria meeting in Washington.

Dr Ackroyd blamed the low level of health and the prevalence of deficiency diseases in rice-eating areas of the world to the preponderance of rice which, he said, supplied over 70 per cent of the calories in general diet.

Dr Ackroyd recognized that a greater consumption of milk, meat and eggs was not agriculturally feasible in much of East Asia but said pulses, vegetables and fish could be made available in much greater quantities.

'The nutritional campaign in East Asia must be part of an energetic attack on-poverty and ignorance which are the basic causes of malnutrition.

'Better nutrition means better health, better capacity to earn and work. Therefore, better nutrition hastens progress and development in general'.

The nutritive value of rice could be improved, Dr Ackroyd suggested, by the use of the lightly-milled rice in place of the highly-milled 'raw' rice generally eaten. This would, he said, conserve the nutrients which are usually removed from rice by washing and heavy milling.—*Food Bulletin*, May 17, 1948.

ALL-INDIA CONFERENCE ON COMPOST

ON the initiative of Shrimati Mira Behn a Conference of provincial workers and others interested in the Compost Programme was held in the Secretariat Buildings, New Delhi, on 16 and 17 December, 1947.

The following delegates attended the Conference :

The Hon'ble Dr Rajendra Prasad, Minister for Food and Agriculture, Government of India (in the Chair)

The Hon'ble Raj Kumari Amrit Kaur, Minister for Health, Government of India

The Hon'ble Pandit K. D. Malaviya, Minister for Development, United Provinces

Mr. S. Basu, I.C.S., Secretary, Ministry of Agriculture, Government of India

Sardar Bahadur Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research

Shrimati Mira Behn, Rishikesh, United Provinces

Shri B. M. Piplani, Deputy Secretary, Ministry of Agriculture, Government of India

Mr. D. K. Bhatia, I.C.S., Development Commissioner, United Provinces

Mr. Shiv Kumar Sharma, Bijnor, United Provinces

Shri Dharam Pal, New Delhi

Dr C. N. Acharya, Chief Biochemist to Government of India

Dr Das Gupta, Ministry of Health, Government of India

Mr. Puri, Ministry of Transport, Government of India

Dr B. N. Lal, Provincial Biochemist, United Provinces

Dr K. G. Joshi, Provincial Biochemist, Central Provinces and Berar

Shri G. L. Patil, Compost Officer, Bombay Government

The Conference was opened by the Hon'ble Dr Rajendra Prasad.

Potential resources of manure

Sardar Bahadur Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research, in welcoming the delegates and requesting Dr Rajendra Prasad, Minister for Food and Agriculture to open the Conference mentioned that as a result of researches carried out under the auspices of the Indian Council of Agricultural Research at Bangalore, a suitable process had been worked out for the composting of town-refuse in India, and this scheme was now supervised by the Government of India, and was operating at 600 Municipal Centres in India producing about 5,00,000 tons of compost per year; but the scope for extending the work was immense, since there were nearly 4,000 towns in India which could produce about 100 lac tons of manure. In the villages a good portion of dung was wasted as fuel. We were losing nearly Rs. 100 crores in importing foodstuffs from abroad. A portion of the above sum, if it had been spent in increasing the quantity of manure prepared in villages, would have not only met our food requirements but would have also improved the fertility level of our soils.

There were huge quantities of cow-dung going waste in our cities, *gowshalas* and grazing areas. The sewage and sludge available in our towns were not being utilized for increasing our agricultural production. It sounded bad economics to leave our resources undeveloped while we continued to import increasing quantities of chemical fertilizers and foodstuffs year after year. The progress achieved so far by our urban and village compost schemes represented barely 1 to 2 per cent of our potential resources and all our attention should be concentrated in the first instance on developing the above resources as rapidly as possible.

Dr Rajendra Prasad

The Hon'ble Dr Rajendra Prasad said that it was a matter of great pleasure to him to preside over the Conference. They have had various experiments in the past with different kinds of manure which would help to grow more food. Whatever might be the individual merits of the different kinds of manure, there was one thing that was sure about farmyard manure, viz. that it not only helped to improve yields, but also kept up the fertility of the soil through the humus added. As such, there was no question that farmyard manure was one of the best forms of manure to be used. There was also this much to be said in its favour that it could easily be made. This did not require big factories or large land for this purpose. It gave wealth with little effort. If only they knew how to utilize all that was wasted, like waste of time, waste of energy, waste of material, waste of food, and last but not least, the waste of what they called waste, a great deal of their problem would be solved.

Sir Datar Singh had given them figures with regard to the amount of compost being prepared, but they had touched only the fringe of the problem. They had been using farmyard manure from time immemorial but they had not yet realized the importance of every bit of cow dung wasted. He was told that not more than one-third of the dung was being utilized as manure, the remaining two-thirds being either burnt as fuel or otherwise wasted. If the remaining two-thirds could also be utilized, they could meet their manurial requirements without any difficulty. The question was how they could do it. Cow-dung was being used for fuel not because the people did not know its use as manure but because they had no other alternative. If they could give them some alternate fuel, he thought a great amount of cow-dung could be kept for manurial purposes. Attempts had been made in certain places to have quick growing trees which would give them fuel, but it required land for growing the trees and they would have to wait for several years before the trees became fit to be used as fuel. His own idea was that as an alternative, they should devote some of the cultivated land for growing crops stems of which could be used for fuel, e.g. castor, maize, cotton and even sugarcane. The Agricultural Departments should carry out research to find out such crops as would give us fuel as well as fodder and food. *Arhar* (*tur*) was an example of such a crop.

There were other things which required their attention. Cattle urine was wasted almost wholly at present. Simple methods of absorbing the same in ash or earth should be introduced in villages. Attempts should be made to conserve human excreta in villages by opening trenched latrines. Village cooperative societies might very well undertake this work. Village *bhangis* could make a living out of the sale of the manure produced. In cities, the problem was somewhat different. All the refuse should be converted into compost. The problem of utilization of cow-dung accumulating in the cities was essentially a problem of transport.

The work should be carried out mainly by the Provincial Governments. Taluka committees and village committees should be made to supervise the work proceeding in their respective areas. Pandit K. D. Malaviya recently inaugurated a Compost Week in the United Provinces under which each village was asked to dig at least one trench and fill it up with compost. Similar propaganda drives would have to be organized in every province. This was a type of work falling in line with the people and easily accepted by them, once the Government was able to convince the people of the advantages of compost-making. The Government of India was prepared to back up the proposals that might be put up by the provinces for the purpose of achieving that object.

Central Compost Development Committee

The Conference resumed its session at 9 a.m. on the 17 December 1947, with Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research, in the chair.

The Conference formed a Central Compost Development Committee consisting of non-officials and officials with Dr C. N. Acharya, Chief Biochemist, Ministry of Agriculture as Secretary, which could act as an advisory body to the Central and Provincial Governments in the matter of compost development. A number of resolutions were passed urging on the Central and Provincial Governments to accelerate the present rate of production of compost from urban and village refuse material. It was estimated that a complete utilization of the indigenous resources would yield nearly 300 million tons of additional manure which would help to produce about 12 to 15 million tons of extra food-grains and also proportionate quantities of fodder for cattle. This would help to meet the present estimated deficit of 4 to 5 million tons of foodstuffs in the country.

During the course of the discussion, the

Hon'ble Pandit Malaviya mentioned that a compost drive had been started in the United Provinces which was expected to yield an extra 48 million tons of compost. Dr Acharya pointed out that the chief limiting factor for increasing compost production at present (especially of urban compost) was transport and motor trucks were in short supply for the purpose. Mr. Puri of the Transport Ministry promised to give necessary help of his Ministry in securing the supply of motor trucks for the purpose.

The members of the Conference later met Mahatma Gandhi in the afternoon. Mahatma Gandhi gave his blessings for the success of the work undertaken by the Conference and while doing so humorously remarked that a good work needed no blessings from him, but if the work was bad, he should not bless it and his blessings would turn into curses.

The following is the text of the resolutions passed by the Conference :

1. This Conference is of the definite opinion that the Compost Programme offers vast potentialities for increasing food production in the country ; thus a systematic utilization of urban wastes would yield about 10 million tons extra manure ; similarly a more efficient utilization of our village wastes would add a further 100 million tons of manure, while a programme for providing alternative fuel in place of cow-dung would release another 200 million tons of manure ; and implementation of the above programme would thus result in the production of an extra 310 million tons of manure which would increase our food production by about 12 to 15 million tons per year as against our present estimated deficit of 4 to 5 million tons and at the same time provide additional fodder and help to improve the fertility level of our soils.

2. This Conference has reviewed the work carried out so far under the existing schemes for composting urban and village refuse and feels that while the work has shown steady development during the last three years, the results achieved so far, which represent only 1 to 2 per cent of the total potential capacity, should be considered insignificant ; and it urges on the Provincial Governments the need for accelerating the pace of the existing schemes, so that :

(a) Under the urban compost scheme, all municipalities notified areas and town committees are brought under the scheme within the next two years and developed to their full production capacity; and

(b) under the village compost scheme, at least 10 per cent of the total number of villages in the province are taken up during 1948-49 and an additional 10 per cent are taken up in each succeeding year.

3. In regard to the Town Compost Scheme, this Conference makes the following recommendations :

(a) In view of the present food situation it should be made obligatory on all municipalities, notified areas and town committees that they should convert the whole of their refuse material into compost and for this purpose the facilities required by them by way of expeditious acquisition of land, procurement of transport, etc. should be provided by the Provincial Governments ; and the municipalities or notified committees should be prohibited from selling uncomposted refuse or night-soil to farmers.

(b) The Health Department of the Government of India are requested to issue a directive to Provincial Governments (Local Self-Government and Health Departments) recommending to them the adoption of the Compost System in preference to other methods of disposal of refuse and strongly urging prohibition of sale of uncomposted night-soil or *katchra* to farmers.

(c) For the disposal of the compost prepared in town areas the help of multi-purpose cooperative societies or Taluka Development Associations or similar existing bodies near town centres should be availed of, more actively than at present.

4. Regarding the Village Compost Scheme, the Conference recommends that :

(a) The scheme should preferably be operated through village *panchayats*, *kisan sabhas* or village cooperative societies ; and in order to help such village organizations with technical advice, demonstrations and training in compost-making and also for the purpose of sending periodical reports, a Compost Supervisor should be posted for each group of 10 villages.

(b) Where the villagers possess insufficient or no land for preparing compost, a common land should be acquired by the Government for the purpose in the immediate vicinity of the village.

(c) In order to popularize the composting habit among the younger generation of villagers, a practical course in composting should be included in the syllabus in all primary and secondary schools situated in villages; and demonstration pits should be kept in routine operation in each school.

5. The Conference considered in detail the problem of conservation of village night-soil and urine and recommended in this connection that simple dry methods should be adopted for this purpose, and appointed a sub-committee consisting of Shrimati Mira Behn, Shri Shiv Kumar Sharma, Dr B. N. Lal and Dr K. G. Joshi (with Dr B. N. Lal as convener) to prepare an outline scheme which could be recommended to provinces.

6. This Conference desires to draw special attention to the huge stocks of cow-dung that lie unutilized in grazing areas, *gowshalas* and cities and urges that special schemes should be drawn up and operated by Provincial Governments for utilizing the above stocks.

7. In addition to the scheme mentioned above, the Conference recommends that suitable schemes should be drawn up and operated in each province for:

(a) the agricultural utilization of town sewage, sullage and sludge,

(b) the utilization of the by-products of the slaughter house and other trade wastes, e.g. wool wastes, mill wastes, leather wastes, etc. and

(c) for the composting of other materials like water-hyacinth, sugarcane trash, press mud, forest leaves, etc.; in cases, where village co-operative societies or individuals do not come forward to utilize the above materials, it would be advisable to prepare the compost under Government auspices till non-official agencies take it up.

8. This Conference is of the opinion that transport has been the chief limiting factor for rapid expansion of the compost scheme and urges on the Government of India and on Provincial Governments to give all necessary help to composting organizations in getting sufficient number of motor trucks for the purpose. It also strongly urges that the trucks at present in use by different Government Departments should also be utilized whenever possible for compost distribution. Transport by canal may also be considered wherever possible.

9. This Conference urges that intensive propangada should be carried out among farmers to point out the value of compost manure and for this purpose it urges on the Central and Provincial Governments to arrange for carrying out the above propaganda through the medium of ballads, dramas, radio talks, lantern slides, films, posters, pamphlets, exhibition stalls, demonstration plots, lecture tours, etc. Existing field publicity vans, newspapers, journals and other media should also be utilized for this purpose.

10. In order to implement the above recommendations and expanded programme of work, the Conference recommends that:

(a) An all-India organization known as the Central Compost Development Committee consisting of non-officials and officials and comprising the delegates attending this Conference as a nucleus, with Dr C. N. Acharya as Secretary, be formed, which would act as an advisory body to the Central and Provincial Governments and meet periodically in different provinces for the purpose.

(b) Each province should have a Compost Development Officer who would be in charge of the urban and rural compost work and allied manurial schemes in the province, including the distribution of fertilizers and oil-cakes; and the staff at the All-India Headquarters should also be adequately strengthened in order to cope with the expanded programmes.

(c) In view of the importance of the Compost Programme sufficient funds should be allocated by the Central and Provincial Governments for implementing the above recommendations and for this purpose, the schemes already included under the five-year development plans have to be suitably amended.

MADRAS

M. KANTIRAJ

COMPLETE figures are now available regarding area and yield of food crops raised in the *fasli* year 1946-47 (ending 30 June, 1947). The comparative statement (Table I) given below furnishes the extent and yield of principal food crops grown during the years 1945-46 and 1946-47. It will be observed that both the area and yield under cereals and pulses have increased considerably in 1946-47 as compared with those of the previous year. The total area under food crops in 1946-47 was 1,202,632 acres more than what it was during 1945-46. There was a corresponding increase in yield also by about 7,07,150 tons.

TABLE I

Comparative statement of the extent and yield of principal food crops

	1945–46		1946–47	
	Area (acres)	Yield (tons)	Area (acres)	Yield (tons)
Cereals	21,834,033	8,948,630	22,807,268	9,952,900
Pulses	2,791,886	223,780	2,935,523	253,550
Condiments and spices	677,174	271,210	768,951	301,510
Fruits and vegetables including root crops ..	821,662	3,313,440	791,662	2,812,180
Sugars	240,600	503,140	291,096	654,070
Miscellaneous food crops	60,369	16,550	33,856	9,690
Total ..	26,425,724	13,276,750	27,628,356	13,983,900

Cereal acreage

Under cereals, the acreage under paddy increased from 10·20 to 10·99 million acres and the yield from 6·33 to 7·34 million tons. The increase is attributable to the 'grow more food' campaign and favourable seasonal conditions. The areas under *cholam* (*jowar*) and *cumbu* (*bajra*) increased from 4·15 to 4·53 and 2·32 to 2·37 acres respectively and that under *ragi* (*Eleusine coracana*) declined from 1·59 to 1·53 million acres. The total area under all food crops increased from 26·43 to 27·63 million acres, an increase of 1·20 million acres.

Ryots' meeting

In order to increase opportunities for personal contact, the Government of Madras have recently ordered holding *jama bandhi* (meetings) in which, ryots would be free to express their problems, difficulties and requirements. Such meetings and discussions would serve to focus the attention of authorities on the problems and measures for their solution and thus bring about a more rapid stepping up of agricultural production. The *jama bandhi* will be held at taluk Headquarters and, wherever possible, at the Headquarters of the *firka* also. In half the number of taluks in each district, *jama bandhi* meetings will be conducted by the Deputy Directors of Agriculture, and in the remaining ones by the District Agricultural Officers.

Revenue Officials of the respective areas will be invited to attend and arrangements will be made to secure the presence of the village officers concerned. The *jama bandhi* Check Memorandum in the form of a questionnaire to elicit the progress made so far, the difficulties met with, and the future lines of work to be undertaken, has been prepared, and the questions will have to be answered.

Improved strains of paddy

At the Paddy Breeding Station, Coimbatore, two cross progenies, strains 3912 and 3840, have been found to be good performers even in a season of heavy infestation of 'Blast'. Arrangements have been made for multiplication of seed material for distribution on a large

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scale in areas where the disease persists in an endemic form.

Results of regional trials on cotton, conducted with two staple hybrid strains, namely Co.4-B-40 and 7682, revealed that the first one is constant in behaviour in all the 14 places of trial and recorded a staple length of 1 to $1\frac{1}{16}$ in. There is every possibility of this strain replacing the strains already introduced, namely Co. 920, Co. 2, Co. 3 and Co. 4.

The study of deterioration of coconut coir yarn when stored in sea water, fresh water, and when exposed to sun and rain, shows that deterioration is the least when stored in sea water, and most when exposed to sun and rain.

Feeding trials with *cumbu* (*bajra*) straw have shown that this straw, which is not usually fed to cattle, can be introduced in graded doses along with roughage even up to 100 per cent without detriment to the health or weight of the animal.

Sugarcane Development Scheme

The Sugarcane Development Scheme submitted by the Madras Agricultural Department was approved by the Indian Central Sugarcane Committee. The Scheme is to last for five years and it is estimated to cost Rs. 3,87,000. While the total quantity of white crystalline sugar consumed in the province is roughly a lac of tons per year, the annual production is only about 40,000 tons. The province has, therefore, to depend on supplies from other provinces in India. The Scheme provides for the starting of four liaison farms in the vicinity of sugar factories. Experiments with promising varieties of sugarcane to test their suitability to the tract, multiplication and distribution of seed material found suitable for the locality, trials of manurial and cultural methods, remedial measures against insect pests and fungus diseases and classification of varieties suitable for crushing in early, mid and late seasons, would be the main items of work of these liaison farms.

The Scheme also provides for investigation of different means by which jaggery production per acre can be increased. The province is already self-sufficient in jaggery and increased production would mean that some land could be released for cultivation of food crops. The Scheme contemplates concentrated work in 24 taluks spread over 13 districts. Organizing seed farms to distribute seeds of improved varieties to growers, advising and guiding them to cultivate their land on scientific lines, arranging for the supply of manure, cane crushers and jaggery-making pans and demonstrating improved methods of making jaggery of better quality, are some of the items of work to be tackled by the taluk centres. It is proposed that the Scheme will be initiated this year.

The Government of Madras have fixed Rs. 54 as price per ton ex-factory for sugarcane crushed by sugar factories during the current season.

Manufacture of malt extract

The factory manufacturing *cholam* (*jowar*) malt extract with shark liver oil, run by the Agricultural Department, has been reorganized and the production target has been increased to 2,200 lb. per month. Orders have been issued to the Surgeon-General to buy the product for use in hospitals. A pilot plant for manufacturing yeast has been set up.

A scheme is under consideration for running a model dairy farm by the Madras Corporation, for supplying milk to the City involving an estimated non-recurring expenditure of Rs. 3,38,140 and a recurring expenditure of Rs. 2,09,546.

The scheme for granting subsidy for sinking wells has been extended for another year from April next. Subsidy for 23,517 wells amounting to Rs. 78,79,863 have been sanctioned. It is expected to subsidize another 20,000 wells.

ORISSA

P. GARTIA

RINDERPEST appears to be prevalent throughout the year in Orissa and more than 50 per cent of cattle mortality is attributed to it. To control this pest serum alone and serum simultaneous methods had to be adopted for a short period but as these were found to be expensive and as many practical field difficulties were experienced, these were abandoned in favour of goat tissue vaccine. The method of goat tissue vaccine is not only found safer but also economical and, at the same time, confers immunity for a longer period against the disease.

Goat tissue vaccine

Prior to 1943 the Veterinary Department was procuring goat tissue vaccine from outside, viz. Indian Veterinary Research Institute, Mukteswar or Calcutta Sera and Vaccine Institute. As a large number of goat tissue vaccine ampoules was required for field use and in order to be independent in regard to this most important biological product, the Government decided to manufacture goat tissue vaccine locally; the necessity of such a step was all the more keenly felt during the period of war when it was found to be rather inconvenient to obtain supplies from outside the province as this method of procurement meant delay and some of the ampoules were rendered impotent during the period of transit. Table I shows the number of goat tissue vaccine ampoules manufactured in the Goat Tissue Vaccine Section and that of cattle immunized actively against rinderpest by the Veterinary Department during the last four years.

It is gratifying to note that cattle mortality due to rinderpest has been checked to a considerable extent. The Provincial Government have further felt the necessity of producing other biological products and have recently started a Serum Institute.

Stockmen training

To assist the Veterinary Assistant Surgeons in charge of the veterinary hospitals and dispensaries in inoculation and other compounding work, a training class has been opened since 1942-43. Thirty trainees are admitted every year and trained in veterinary and animal husbandry practices for a period of 10 months by a Senior Veterinary Officer in accordance with the syllabus prescribed by the Department. These stockmen have proved to be quite useful in conducting goat tissue vaccine inoculation against rinderpest.

TABLE I

Numbers of ampoules manufactured and cattle inoculated

Year	Number of goat tissue vaccine ampoules manufactured (one gram each)	Number of cattle inoculalated
1943–44	3,651	2,92,526
1944–45	4,824	3,67,659
1945–46	4,335	3,00,711
1946–47	4,543	2,88,938

Mass immunization of cattle against rinderpest

This scheme has been sanctioned by the Provincial Government and would be taken up during the year 1948-49 with desiccated goat tissue vaccine in selected areas of the province.

Improvement of cattle

The general condition of cattle in Orissa is rather poor; draught animals are stunted in growth and the milk-yield of cows is remarkably low. Considering all these facts the Provincial Government have already introduced a system of grading the local cattle with the Hariana breed. Therefore a large number of pure Hariana bulls have been brought from the Punjab through the Utkal *Go-mangal Samiti* and these are maintained at different institutions like veterinary hospitals, dispensaries,

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jails, *gowshalas* and also by private bodies for the purpose of breeding and thus effecting improvement in the prevailing type of cattle. To achieve success in the desired direction, castration of scrub bull calves is being vigorously carried out.

Improvement of goats

In order to bring about improvement in the local breeds of goats in the province as regards yield of milk and meat studies have been undertaken of crosses between Beetal and South Orissa goats.

SEED SOWN SUCCESSFULLY FROM THE AIR

AERIAL sowing of seed has been carried out successfully—and cheaply at Gayndah in Queensland. Pastoralists are keenly interested, as grazing areas in Queensland are extensive and hand-sowing a gigantic task. Experiments were carried out on an area of 300 acres, over which seed was laid in even swathes from an Anson aircraft. Twin hoppers having a carrying capacity of 56 cubic feet were fitted to the plane. These hoppers with extensions of the same dimensions held the seed in flight, and a slide trap operated by the pilot exposed the load to air pressure. The seed was sucked through twin tubes below the wing roots, and was spread by the air stream from the propeller to fall evenly along the ground. Sowing was carried out over difficult terrian at the rate of 180 acres an hour, and at one-third the cost of hand-sowing. It is estimated that one man would have taken 82 days to do the same work by hand. If the experiment proves successful, these economical methods open up vast possibilities for the improvement of pastures on some of the large pastoral holdings where sowing by other methods is often unpractical because of the heavy cost and labour involved.—*Agricultural Newsletter*, No. AGN/191.

Across the Borders

THE ROYAL BOTANIC GARDENS, KEW*

By SIR EDWARDS SALISBURY

THE Royal Botanic Gardens at Kew are an institution that, in a typically English way, had its origin in private enterprise. Initiative dates back to some 180 years ago, when Princess Augusta (mother of George III) began to form a botanical collection which the acumen of Sir Joseph Banks quickly raised to the first rank of importance. Even so, the collections declined in the early years of the 19th century and might have been lost as a national asset had it not been for the report of Lindley, the first Quain Professor of Botany at University College, London. Now, more than a century later, another Quain Professor has become Director. The Gardens as we see them at the present day owe much of their planned beauty to the first two Directors, Sir William and Sir Joseph Hooker. The Hookers were followed in turn by Sir William Thiselton Dyer, Sir David Prain, and Sir Arthur Hill, each of whom effected further improvements. The extent of the Gardens to day is some three hundred acres—a far larger area than the original garden—and it is because a second garden was joined to the first that the plural still persists in the official title. Many of our countrymen in Britain are rightly proud of Kew, but its real value is probably more appreciated, and for better reasons, by our kith and kin overseas than by those at home. The latter too often regard Kew as an especially attractive public park, and though its value as a summer resort amid floral beauties must not be underrated, yet the wider recognition that this aspect is but a by-product of its real function might perhaps induce a greater and more intelligent regard for the specimens it contains. The number of living species which are here cultivated is quite remarkable, and it is a tribute alike to the horticultural skill of the garden staff and to the adaptability of the plants themselves that even in the open there are to be seen many thousands of species culled from the most diverse regions and soils. In the Temperate House, probably the largest glass house in the world, over an eighth of a mile in length, are to be seen the Acacias and Epacrids of Australia and New Zealand; the Camellias of Japan; a wonderful display of Tree Ferns, Rhododendrons from the Himalayas and Java; the marvellous pink blossoms of *Magnolia Mollicomata*; and the flamboyant blooms of Tibou-China from tropical America. Or we may walk over to Decimus Burton's masterpiece, the great Palm House, so well proportioned that its great size—more than 360 ft. long and 66 ft. high—is but half-realized. Here a collection of Cycadaceae gives us some faint idea of what the vegetation of the earth must have looked like in Jurassic times, when plants of this affinity were an important feature not only in the tropics but elsewhere.

Here too we see the Screw Pines, and tall Palms striving to push through the roof. Or again we go to the Tropical Fern House and see Giant Ferns on the one hand and on the other the puny modern descendants of the giant Lycopods that formed so marked a feature of Coal Measure forests. Then, having thus paid tribute to the outmoded fashions of plant life that achieved their zenith in former epochs, we wander out into the Arboretum, where thousands of species of Dicotyledonous and Coniferous trees represent the Dominion types of the arboreal vegetation of the present day.

All these collections of living plants, comprising more than forty thousand species grouped to please as well as to enlighten, are but a part of the mechanism that Kew provides for the accurate naming of plants and the growth of knowledge of the vegetable kingdom. Indeed, the living collections form a supplement to the Herbarium housed in the extensive buildings to the north of the main entrance, where more than five million specimens are preserved—a vast collection in which the proportion of types, co-types, and para-types is incomparably high. For this reason the Kew Herbarium

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FIG. 1.
(right). Museum No. III erected by Sir William Chambers in 1761.

FIG. 2.
(bottom left). The Pagoda, a relic of the Oriental phase (1761).

FIG. 3.
(bottom right). A glimpse of the Cycad collection in the Palm House.

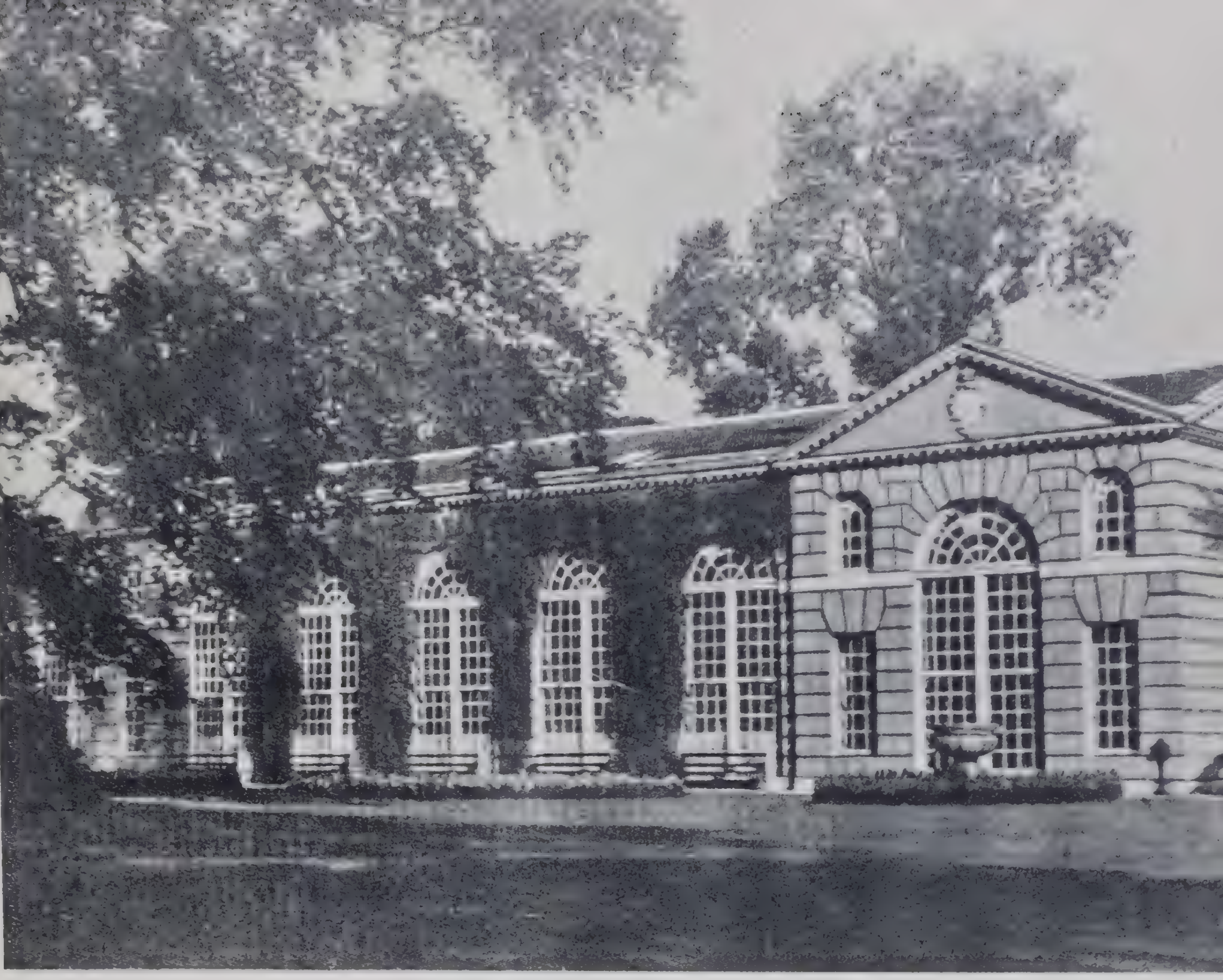
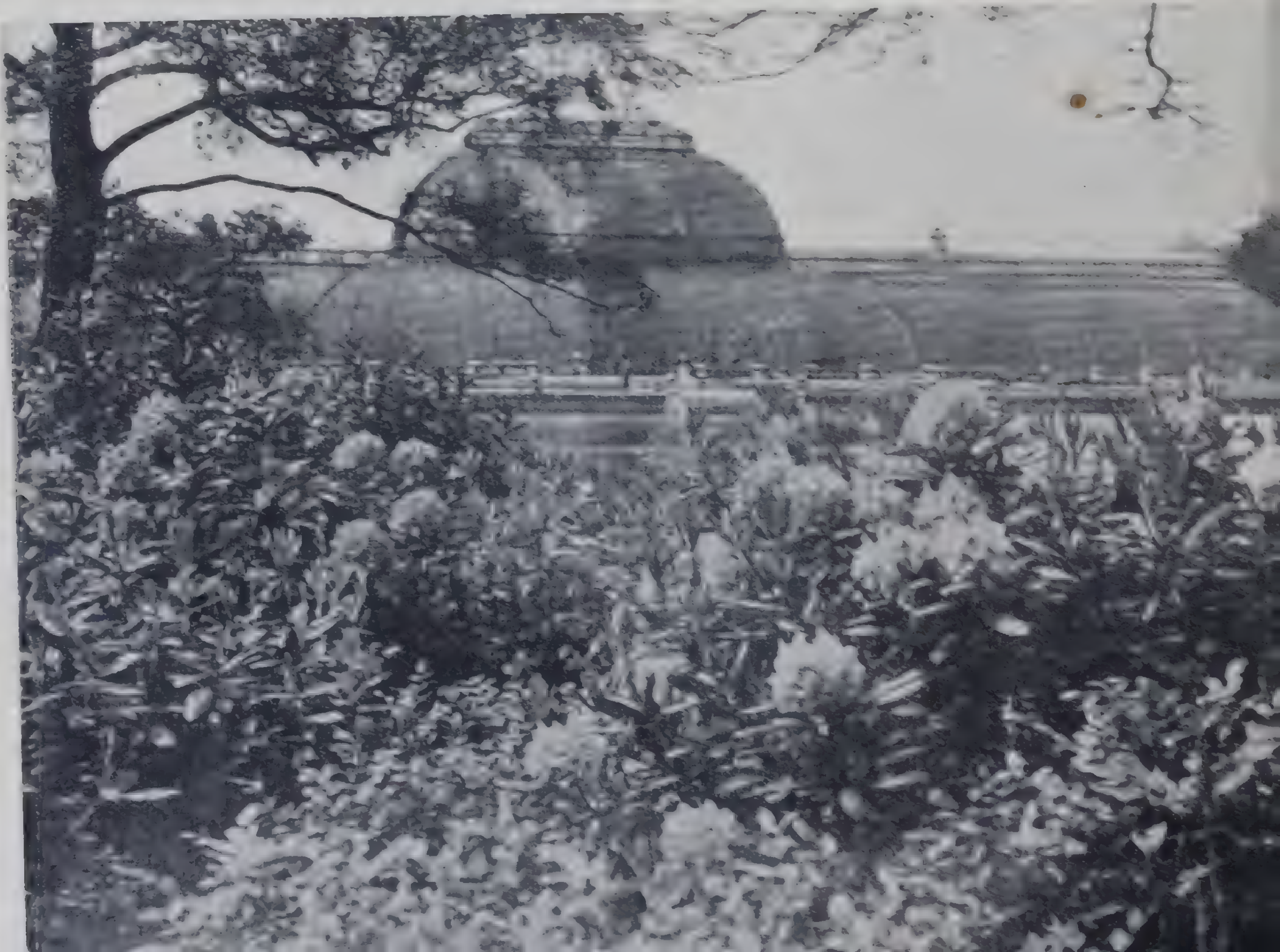


PLATE 17

FIG. 4. (above). Rhododendrons and tulips in the Broad Walk.

FIG. 5. (left). Part of the Rock Garden.

FIG. 6.
The Palm House, Decimus Burton's masterpiece, erected 1844-8.



far surpasses in importance any other collection of such a cosmopolitan character in the world. Hence it is that Kew is the taxonomist's Mecca, and systematic botanist from all over the world are in normal times, to be found carrying out research within its walls. Naturally, the Kew collections are especially rich in types from the British Empire, and Kew has thus been the source of production of a long series of floras, from the famous *Flora Antarctica* and the Flora of British India, published between 1872-1897, which treated of some 14,000 species, to the Flora of tropical West Africa which appeared just before the recent war. Here too is produced the *Index Kewensis*, in which are enumerated the Latin binomials of all flowering plants, with references to the source of the original description. Every five years a supplement is issued to include all newly described plants in this category. The whole constitutes an indispensable tool for all botanical taxonomists. Much of the knowledge and experience of Kew in respect to the taxonomy of particular regions is embodied in the series of Floras already referred to, and in numerous monographs of particular families or genera. The Herbarium with its large library is in fact an extensive taxonomical research institute, where the permanent staff and visiting scientists are continually advancing our knowledge of the world's Flora.

The *Kew Bulletin of Miscellaneous Information* is the means of recording much of the more specialized research that is carried on at Kew alike in the fields of pure taxonomy, planned morphology and anatomy, economic botany, and botanical exploration, and it is a matter for concern that the destruction of the stocks of this periodical by enemy action precludes our meeting the numerous demands for copies that we have received from all over the world.

In the Jodrell Laboratory, research work of an experimental character is carried on, and this laboratory is also the department of the gardens concerned with anatomical investigations. Here has been produced a new taxonomic account of the anatomy of dicotyledonous plants, to be published by the Oxford University Press in the near future. This will embody the information contained in the English edition of Solereder, in preparing which Dr Boodle (Late Keeper of the Jodrell Laboratory) played so large a part, together with the mass of information accumulated during the past forty years. It was in this laboratory that the classical physiological experiments of Brown and Escombe were carried out, that D. H. Scott did most of his work on fossil plants, and that during the war the possibilities of rubber production from the Dandalion (*Taraxacum koksaghys*) in English conditions were assayed. Here, too, methods of propagation by growth-promoting substances and taxonomic cytology have been studied. Like the Herbarium, it furnishes accommodation for visiting scientists working on the plant material Kew can so richly provide.

Four museums of Economic Botany in different parts of the Gardens house the extensive collection of plant products. They provide not only an indispensable means of reference for the multitudinous inquiries that come in from all parts of the globe, but act as a valuable source of research material. The vast collection of fibres, timbers, drugs, and food products, both in the raw state and in manufactured form, is here to be found arranged on a taxonomic basis.

Thus the four major divisions of the organization of the institution, namely the Herbarium, the living collections, the museums, and the Jodrell Laboratory together constitute a powerful instrument for research and information concerning the identity and characteristics of plants and their products.

But while the living collections are of first importance as a supplement to the *hortus siccus*, they play, and indeed have long played, a most important role as a source for the distribution of economic species throughout the Empire. The part which Kew played in the initiation of plantation rubber and the cinchona industry is too well-known to need reiteration. Kew was also responsible for the dissemination of cocoa and oil palm to West Africa, of pine apple to a number of areas, of the nut *macadamia ternifolia* to Hawaii, and more recently of the oil-producing tree Aleurites to various Dominions and Colonies. These are but a few examples of the extensive plant distribution which has been rendered possible by the skilled use of the Wardian case. In connection with banana-research in the West Indies, Kew functioned not only as a distributing agency but also as a quarantine station. This latter aspect has again added emphasis with the increased importance of virus diseases, for unless plants carried from one part of the world to another are healthy their distribution may be a menace rather than a service.

The vast numbers of visitors to Kew every year are a testimony to its great popularity as a resort, and though for many the Gardens are but a beautiful amenity, they provide for many others a permanent horticultural display where newly introduced or rare species can be seen by the botanical students, the research worker, and the professional or amateur grower. The three stout volumes of *Trees and Shrubs Hardy in the British Isles* by W. J. Bean, a former Curator at Kew, is a gardening classic that embodies much of the cultural lore that has been accumulated during the passage of years. Another such is *The Botanical Magazine*, which was started by William Curtis* but for more than a century has been edited at Kew and contains coloured illustrations and descriptions of new or noteworthy species. It will be realized that the cultural experience of more than a hundred years which has been amassed at Kew enables it to serve as an unusually well-equipped training-ground for horticulturists, and many former Kew students now occupy positions of importance the world over. Moreover, the wide range of material which the gardens can furnish is constantly drawn upon for research in many fields of scientific activity.

Almost every post brings requests for such material. It may be to test the active principal of some plant alkaloid, to investigate the chromosome number of a suspected polyploid, or to compare the epidermal characters of a living cycad with those of a Jurassic prototype. It is needless to say that, owing to limitations of space and staff, Kew cannot attempt to supply educational material in the broader sense, but in so far as its resources are required for genuine research these are placed freely at the disposal of investigators in universities and other recognized institutions of higher learning—as far as is consistent with the proper maintenance of the collections. The intercourse with overseas Botanists is now a highly prized tradition, and it is pleasant to record that though war-time conditions diminished this activity they never caused it to cease, and that it is already being resumed.

The original Botanic Garden was only about nine acres in extent and remained little more until shortly after 1840, when, during the first directorship under Sir William Hooker, most of the present land was added. The only substantial extension since that period was the area of 37 acres presented by Queen Victoria. This comprises the Queen's Cottage grounds, which as they were left with the proviso that they should remain more or less in a wild state, cannot be appropriately used for planting other than native species.

The area thus acquired a century ago seemed ample—hence the lavish expenditure of space on multiplication of the same species in avenues and in other ways. Since that time the vast influx of species, from both the Old World and the New, has, especially so far as trees are concerned, strained the limits of Kew severely, and at the present time, an appreciably larger area would be more than welcome, whilst the glass houses are now far from adequate.

The Palm House took four years to construct and was completed in 1848. The Temperate House was erected some ten years later and, like most of the glass houses at Kew, is now too small to meet present needs, despite the fact that it occupies about three-quarters of an acre. Both these houses suffered from enemy action during the late war, a large proportion of the glass of the Temperate House being broken when a heavy bomb exploded in the fork of a near-by beech tree. It is tribute to both the skill and the devotion of the staff that the resultant losses in plants were much smaller than expected. The Orchid Houses, enriched by gifts from the collection from Sir J. Colman, now contain a remarkable collection of orchid species. The remaining houses contain collections of economic species of tropical and temperate ferns and insectivorous plants, whilst for the general public the *Victoria regia* House, where the giant annual species flourishes, is perhaps the greatest attraction after the conservatory devoted to decorative plants.

Out of doors, the 'order beds' provide valuable material for students, while most of the shrubby and arboreal species are also grouped taxonomically. A recent departure from this tradition has been made, in the interests both of efficient culture and of educational value, by the establishment of a chalk garden.

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* See *Endeavour*, Jan. 1946.

The different parts of Kew exhibit a variety of styles in landscape gardening, but fortunately, as befits a botanical garden especially, the English style, which we owe in considerable degree to the influence of Kent, Sir W. Chambers, and Pope, who lived at Twickenham, is that which preponderates. Thus so far as conditions permit the ideal aimed at is the display of the natural growth and habit of the species concerned and indeed the motto of Kew might well be 'Science and Beauty'.—Reproduced from *Endeavour*, April 1947.

ERRATA

Indian Farming, Vol. IX, No. 3, March 1948, 'The Deccan Trap Region: Possibilities of Development'.

Page 110, Line 15 (col. 1), *for* 'deep' *read* 'broad'.

Line 4 (col. 1 from bottom), *for* 'The Sanhyadris superimpose laterite as they reach the limits of the Bombay Province' *read* 'The Sanhyadris are superimposed by laterite as they reach the southern limits of the Bombay Province'.

Line 12 (col. 2), *for* '45,000 ft.' *read* '4,500 ft.'

Line 15 (col. 2 from bottom), *for* 'Along the sea coast the rainfall towards the south is the highest and comes down to about 150 in. as one travels northwards to Bhatkal' *read* 'Along the sea coast the rainfall towards the south is the highest at Bhatkal going up to 150 in. and becomes less as one travels northwards'.

Line 6 (col. 2 from bottom), *for* '10 in.' *read* '20 in.'

Line 2 (col. 2 from bottom), *for* 'Waniganga' *read* 'Wainganga'.

Page 111, Line 2 (col. 1), *for* 'south-east' *read* 'south-west'.

Page 112, Lines 4 and 12 (Col. 1), *for* 'Veniganga' read 'Wainganga'.

Line 15 (col. 2), *for* '25,000 ft.' *read* '2,500 ft.'

Home Gleanings

DAMODAR VALLEY CORPORATION

THE first major undertaking of the Government of India, the Damodar Valley Corporation, has entered the final stage with the passing of the Damodar Valley Corporation Bill by the Dominion Assembly recently. The Hon'ble Mr. Gadgil and his Ministry deserve to be congratulated on enacting this measure, the agricultural and industrial potentialities of which are great indeed. As the Minister for Works, Mines, and Power rightly remarked while replying to the debate on the Bill, this measure is 'the first of its kind in the right direction to eliminate poverty in this country, which is really the fundamental problem'.

Central Corporation

The Bill, in its modified form, aims at appointing a Central Corporation on the T.V.A. model which will be in sole charge of administering the project, both during construction and after. The Bill which was referred to a Select Committee some time ago, emerged from it in an improved form in as much as the scope and functions of the Corporation had been widened. The D.V.C. will be composed of a chairman and two members, to be chosen by the Central Government, the latter in consultation with the Governments of Bengal and Bihar. The Corporation will be an independent body run by persons chosen on merit alone. This is as it should be, as the undertaking affects a large number of people of more than one unit and as the administration of the project as a whole can be better handled by an independent body composed of men of capacity and sterling qualities. In view of the large finances involved, the Governing Body of the Corporation will be assisted by a Financial Commissioner.

During the discussion on the Bill, an important point arose whether 'the Corporation shall be liable to pay any tax on income, corporation tax or any other tax levied by the Central Government'. Before the House rejected an amendment to the original clause to the effect that the Corporation be exempted from liability to pay any tax, the Minister for Works, Mines and Power, replying to the discussion, rightly stated that, if the Centre had to help the provinces when they were in difficulties, it would only be proper to leave some source of revenue to the Centre. Further, as he confidently pointed out, it would not be long before the Corporation became not only self-supporting but would yield something to the Central Revenues, and when it does so, automatically a portion will go to the provinces.

It may be recalled that, early last year, due to the commendable efforts of the Hon'ble Mr. C. H. Bhabha, the then Minister for Works, Mines and Power, a tripartite agreement was reached between the Governments of the Centre, Bihar and Bengal, the three parties concerned with the implementation as well as benefits of the scheme. That was a distinct achievement as, prior to it, prospects of the scheme taking definite shape were gloomy, for the three parties concerned continued to disagree among themselves on some point or other. Now that the Bill has been passed and the Corporation is to come into being shortly, it may be confidently hoped that the actual construction work will start at an early date.

Flood control

The Damodar River—notorious for its erratic disposition causing thereby frequent flood damages—flows through the provinces of Bihar and Bengal and drains a vast area called, on account of its industrial potential, the 'Ruhr of India'. As such, flood control is an important aspect of the scheme. It shall be the duty of the Corporation to promote the agricultural, industrial, economic and public health area within its operation. And in order to carry out these functions, the Corporation may establish, maintain and operate laboratories, experimental and research stations, and farms. Flood control will be obtained by constructing a number of dams across the Damodar River and its tributaries with large storage reservoir which will hold back the floods. The total storage capacity of the reservoirs has been estimated at about 3,569,000 acre feet. The flood waters and the annual flow will be converted into a perennial flow and will be harnessed to develop electric power. The total installed capacity of all hydro-electric stations put together will be about 200,000 k.w. After the completion of the project, sufficient water will be stored for release to meet the irrigation requirements of about 763,000 acres in four districts of Bengal alone. The scheme is expected to be completed within a period of ten years, if not earlier. It will cost over Rs. 55 crores.—Reproduced from *Commerce*, 28 February 1948.

GREEN MANURING OF PADDY*

THE principal food crop of the province of Madras is paddy and though it is cultivated in all the districts, the food supply falls short of our requirements. This is because the average yield is low, being about 1,600 lb. per acre as against 6,000 to 7,000 lb. obtained in Japan, Spain and Italy. It is not difficult to improve the yield of paddy. For instance, in some of the Government Agricultural Research Stations, where the yield was formerly about 1,600 to 2,000 lb., the yield is now 3,000 to 4,000 lb. per acre.

Food can be produced only from the soil and no amount of talking will help us to produce more food. If food supply is to be improved quickly, the soil has to be tackled by manuring. The question of manure supply is, therefore, indissolubly bound up with the well-being and even the bare existence of our people.

Green leaves as manure

The manures commonly applied to paddy fields are farmyard manure, green leaves, oil-cakes, bone-meal, fertilizers like sulphate or phosphate of ammonia, super-phosphate, etc. But the supply of these is at present limited. The only type of manure which can be increased considerably and that too in a short period is green leaves. Experiments in the Agricultural Research Stations and on ryots' fields in all districts have proved the universal efficacy of green leaves in improving the yield of paddy. The percentage of increase in the yields varies from 25 to 45 per cent. A maximum response of 50 per cent was noticed with an application of 6,000 to 8,000 lb. of leaves in the case of the Circars Districts and West Coast soils and 9 to 17 per cent in the Cauvery delta and Coimbatore District. The average dose is about 4,000 lb. or 3 cart-loads of green leaves per acre. It will be seen that every 40 lb. of green leaves will secure an increase of one Madras measure of paddy. The more leaves we apply as manure, the more food we produce. The solution sounds so simple yet the food shortage has been chronic.

Green manure crops

There are two ways of growing green leaves for use as manure for paddy fields. The first is to raise a green manure crop like *Pillipesara*, *Kolinji*, (*Vempali*), *Daincha*, Sann hemp, *Sesbania speciosa*, etc. on the paddy field after the harvest of paddy and plough it in before transplantation.

Pillipesara thrives well on stiff soils ; *Kolinji* on light soils, Sann hemp on medium soils, *Daincha* and *Sesbania speciosa* on all types of soils. *Daincha* is also particularly suited to alkaline lands. The seeds of green manure plants are generally sown before the harvest of paddy when there is some moisture in the field and the green manure crops thrive on the summer showers where there is no scope for irrigation.

Of the green manure plants, *Kolinji* has the great advantage of being self-sown after it is once introduced in any area, i.e. when once the crop is established in a paddy field, the *Kolinji* seeds that scatter from the plant, germinate after the paddy is harvested and therefore there is no need to sow the seeds again in future years. *Kolinji* grows on waste lands and the seeds can be gathered by village children in their spare-moments. It pays to collect the seeds as the price will be raised from Rs. 12 to Rs. 18-6-0 for a bag of 160 lb. from 1 December 1947.

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* By the Director of Agricultre, Madras.

Pillipesara and sann hemp are also greatly valued as cattle fodder. *Sesbania speciosa* will produce a lac of pounds of leaves per acre. It decomposes easily in the paddy field as the stem is pithy and its chief merit lies in the fact that it can thrive under the swampy conditions of the paddy field. When planted along the edges of a paddy field in July at the time of transplantation of paddy, each plant produces about quarter of a pound of seeds by December and a few dozen plants will produce the seeds required for sowing in an acre by December. The ryot will not, therefore, be put to the expense of purchasing the seeds every year.

The seeds of green manure plants are not now available in plenty and this will be the case until the wet-land ryot learns to produce on his holdings, his requirements of seeds even by setting apart a part of his land for this purpose. In order to encourage the production of green manure seeds, the Madras Government have recently offered a subsidy of Rs. 6-8 on every 160 lb. of seeds produced.

Quick growing shrubs

The second method is to raise quick growing shrubs on the bunds of fields. This will suit all areas and in particular all places where there will not be sufficient interval between the harvest of one crop and the transplantation of another to raise a green manure crop on the field. A quick growing shurb like *Glyricidea* (*Eruthazai* in Tamil and *Rotta Aakku* in Telugu), *Adathoda* (*Addasaram* in Telugu), *Calotropis* (*Erukkan* in Tamil and *Jilledu* in Telugu), *Leucaena* (*Kottamanakku* in Tamil and *Nepalem* in Telugu), *Jatropha* (*Malaipoovarasu* in Tamil and *Konda Ganna Ravi* in Telugu), may be raised in backyards of houses, village sites, vacant places, sides of roads, along tank and channel bunds. The leaves of most shrubs stand frequent lopping and no trouble is involved in maintaining them except the initial effort in planting a branch or a stump. Various kinds of trees also give abundant supply of leaves, like *Pungam* (*Kanuga*), *Odiyam* (*Gumpena*), *Vadanarayana*, etc. But for quick results, the quick growing shrubs may be preferred.

Glyricidea, Leucaena, etc. are particularly to be recommended as these can be raised from small cuttings and are very quick growing and the roots harbour certain types of bacteria which absorb atmospheric nitrogen for the benefit of the host plant. *Glyricidea* and *Leucaena* are therefore the poor man's fertilizer factories which go on yielding a more or less balanced manure in the shape of green leaves, in spite of repeated loppings. Each *Glyricidea* plant will give 40 lb. of leaves in the first year and up to 300 lb. a year after the third year. If *Glyricidea* is raised on the paddy field bunds, the ryot will have his manure on the spot ready for use when he gets water for irrigation. If necessary, he may even slightly enlarge narrow bunds in places where the stump is planted. Even if 100 plants are planted on the bunds of an acre by enlarging 9-inch bunds to 2 ft., the extra area encroached on the field will be less than 1/300th of an acre. It is not necessary to plant *Glyricidea* on all the bunds, as some will be required for use as paths and for other purposes.

Leucaena is a thin medium-sized tree which has the great merit of possessing a hard wood which can be used for making agricultural implements, for fuel and for house construction. In the irrigated area *Leucaena* will serve the ryots' fuel problem and help him to conserve the cattle dung for manuring fields. These two shrubs can be raised on paddy field bunds without detriment to the crop.

It should be realized that unless more leaves are grown more manure cannot be produced and more food will not be forthcoming. The initial effort is not difficult and the gain is enormous.

With abundant supply of organic manure to the fields we can apply fertilizers without risk to the land. Then only can we have hope to get the phenomenal yields obtained in Japan, Spain and Italy. Madras should not lag behind these countries and it need not provided a province-wide campaign is successfully conducted to plant more shrubs and trees. Trees and shrubs can be planted throughout the year under suitable conditions and it is never too late to start planting them. Remember that if every ryot plants even one useful plant a day and utilizes the leaves for manuring paddy fields, there will be no food scarcity next year or thereafter.—Reproduced from *Madras Journal of Cooperation*, December, 1947.

Book Reviews

THE EVOLUTION OF *GOSSYPIUM* AND THE DIFFERENTIATION OF THE CULTIVATED COTTONS

By J. B. HUTCHINSON, R. A. SILOW and S. G. STEPHENS (Godfrey Cumberlege, Oxford University Press, 1947, 15s. nett).

THE production of commodities of high quality and in larger quantities with a view to ensuring a higher degree of self-sufficiency in regard to them occupies in the post-war programmes of reconstruction undoubtedly an important place of priority in the different countries of the world. However, success in attaining the targets in view largely depends on the availability of improved types and high yielding strains of crops, capable of being cultivated over large areas. Intensive crop breeding based on a thorough understanding of all aspects of each individual crop, therefore, constitutes the most important link between the demand and supply. Comprehensive studies in the fields of taxonomy, genetics, cytology, agronomy, distribution, etc. form an essential prerequisite for the understanding of any crop. No other single institution has perhaps contributed in modern times so much to the advancement of fundamental knowledge of so difficult a crop as cotton with its world-wide distribution and panorama of forms or species, as the Cotton Research Station at Trinidad which was established by the Empire Cotton Growing Corporation in 1926. The programme of the Genetics Department of this Station included a very extensive and intensive study from living material of the genus *Gossypium.* The closing of the Trinidad Station is now the occasion for a review of the work carried out there.

'The Evolution of *Gossypium* and Differentiation of the Cultivated Cottons' by J. B. Hutchinson, R. A. Silow and S. G. Stephens, well-known workers in the field of cotton research, embodies, as is stated, a review of the genus as a whole and an account of its evolution and present status which is sufficiently broad-based on experimental evidence to be generally acceptable to cotton workers for the proper planning of cotton breeding work. There is no gainsaying the fact that the publication records a great advance in our knowledge of the genus *Gossypium* and it serves not only as a guide for the successful planning of crop research covering the whole of the crop plant genus, but also as an excellent basis for the Cotton Botanist to formulate his programme of synthesis of economic characters.

The book is divided into four parts. The first entitled 'the classification of the genus *Gossypium*' is the work of Hutchinson. He has given a classification of the genus *Gossypium* based on genetic and cytological data which is simple, reasonable and comprehensive. The genus has been classified into eight species groups or sections, (1) *Sturtiana,* (2) *Erioxyla,* (3) *Klotzschiana,* (4) *Thurberana,* (5) *Anomala,* (6) *Stocksiana,* (7) *Herbacea* and (8) *Hirsuta.*

In connection with the discussion on the differentiation of the *arboreum* species, the author has, owing to lack of information, made no formal taxonomic sub-division of *G. arboreum* but has accepted Silow's six geographical races as representing the best natural sub-division of the species. The collection, however, of sufficient data for the proper understanding of the *arboreum* species seems a great necessity.

The Wagad type (in the opinion of the authors of Part III) is a connecting link between the Persian and Western Indian types of *herbaceum.* The inclusion of Punctatum and Marie-galante varieties of *hirsutum* is a new feature. The Kidney cottons of the Brazilian forests and the wild types of *Darwinii* have been given varietal rank under *barbadense.*

Under the caption of 'the evolution of the species of *Gossypium*', which is the subject matter of the second part of the book, Hutchinson and Stephens have given an outline of the status of the wild species and of the major factors which governed the evolution of the present day cultivated cottons of the old and new worlds from them. The study revealed that notwithstanding the distribution of the wild species in all the continents which extend into the sub-tropical region, they are characterized by low genetic variability, absence of geographical races and little tendency to spread. *Anomalum* was found to be the only species widely distributed and *G. harknessii* × *G. armourianum* the only interspecific cross giving fully fertile F_1.

The third part, coming from the pen of Hutchinson and Silow, embodies an account of the several factors that influenced the differentiation of true cottons.

The available information as to the antiquity of the cultivated cottons seems to point to the Indus Valley as the spot where cotton was first used but the cytogenetic data appear to be conclusive that the progenitors of the early cottons of the Indus Valley must have been introduced from southern Arabia or north-eastern Africa. The measurable link characters of the cotton used in the fabrics discovered at Mohenjo-Daro (3000 B.C.) were found to be within the range of the Indian cottons of the present day, making it certain that the evolution of lint had already been completed by then.

Coming to the origin of the New World cottons, it is stated, on cytological grounds and on the evidence of reproducibility of characters of the New World cottons in the hybrids derived from a cross between Old World × *G. raimondii*, that the New World cottons must have originated from the hybridization of an Old World cotton with *G. raimondii*. The next problem that the authors set themselves to find is as to how the two parents came together so that hybridization could take place. They do not accept the land bridge theory put forward by Harland. The alternative suggestion of the authors, that the wanderers from the ancient culture centres of the Old World must have planted their cottons (Asiatic) in north-western South America and that hybridization must have occurred there— the cultivated Asiatic serving as the female and wild American, *G. raimondii*, as the male—is of absorbing interest. On the question as to whether the Asiatic cotton was of *arboreum* or *herbaceum* origin, Hutchinson and Silow concluded that the only deploid species that could have been carried across the Pacific to western South America was *G. arboreum* or a species ancestral to it.

The authors conclude the part by drawing attention to the need for a comprehensive study of the measurable characters of cotton lint. They expect that such a study of the modern cottons together with an examination of material from the fabrics of ancient India and Peru would largely elucidate the history of the development of quality in cotton.

Hutchinson and Stephens have, in the fourth part, dealt with the significance of *Gossypium* in evolutionary studies.

The distribution of the centres of variability of the more important genera of crop plants is stated to illustrate the intimate association that existed between the rise of human civilization and the development of crop plants. The distribution of variability in the crop plant genera common to both hemispheres is another point adduced in support of the theory of trans-Pacific rather than an Arctic link between them. The authors further go on to say that the Indian centre is characterized by a heavy preponderance of plants reproduced by seed, whereas the Indo-Malayan plants are vegetatively propagated. They infer that since none of the Indo-Malayan plants—not even the coconut—has been established in the New World long enough to have developed centres of variability, it is evident that the trans-Pacific migration was carried out by people in direct contact with India and not by a race long established in Indo-Malaya.

The authors conclude that the outstanding feature of the discussion of differentiation in *Gossypium* has been the importance of variability and despite the need for uniformity in the product to meet market requirements, future programme must be designed for the maintenance of variability rather than for the isolation of pure lines.

The book contains at the end a comprehensive bibliography and an exhaustive index.

Literature on crop botany contains perhaps few such publications of specialized studies on a single genus, which have thrown a flood of light on the origin and differentiation of species and have enabled a clearer understanding of the genetic make up of the present varieties. The 141 pages of this book are studded with valuable information.

The conclusion seems inevitable that crop research which aims at high targets in respect of economic characters of a crop should not fight shy of the investigation of the fundamental problems but should be planned on as wide a basis as possible so as to include within its scope the integration of specialist sciences.

This book should be read by all botanists and agricultural workers, whatever be the crop or branch of Science they have specialized in. (K. D.)

⁂

NEW BOOKS RECEIVED

1. *Indian Parties and Politics*—Edited by S. NATARAJAN (Published by the Oxford University Press, Bombay, 1947, pp. 21, As. 6.).
2. *The Chinese Method of Artificial Incubation of Duck's Eggs in Large Numbers at a Time*—by Rao Bahadur V. K. MENON (Published by Harsha Printing and Publications, Puttur, S. K., 1947, pp. 23, Rs. 1-8.).

OVERCOMING WORLD FOOD SHORTAGE

SIR John Boyd-Orr, retiring Director-General of the U. N. Food and Agricultural Organization, proposed in London recently that the British Commonwealth should take the lead in plans for world cooperation to overcome increasing food shortages.

'Moral and spiritual leadership in a sick world by the Commonwealth of free nations is probably man's last chance of averting the greatest catastrophe in history', he said.

A Commonwealth plan for increased food production should be lined through the World Food Council with a global plan, he said. The increasing world food shortage was a greater threat to civilization than the atom bomb.

He hoped the forthcoming Commonwealth conference would be the first of a regular series which would soon include delegates of the non-self-governing colonies—as far as possible representatives of all races, colours and creeds. 'The new world must have no colour bar', he insisted.—*Food Bulletin*, June 7, 1948.

News and Views

ROTATION OF ‘LAND FARMING’ WITH ‘WATER FARMING’

FRENCH farming is noted for its efficiency. It is based on the principle of working with Nature; of adapting the crops to the land, rather than attempting to adapt the land to crops, and of utilization of all factors of soil and water—physical, chemical, and biological. With respect to some of these factors neighbouring farmers cooperate, as in the use of waters. The Upper Rhone Valley* is dotted with ponds, most of them man-made. The location of these ponds is shifted from year to year, in accordance with each farmer's rotation of ‘land farming’ with ‘water farming’, based on co-operative arrangements respecting the use of waters.

These temporary ponds may vary from a few acres to six or seven hundred acres. The most satisfactory location is a slightly depressed, typical grain field. This area, can, if necessary, be surrounded by an earth dike to insure the size and depth needed to capture and retain the usual run-off. The depth, which varies with the danger from ice, the local rate of evaporation, and with the amount of rainfall or stream water which may be expected to replace the evaporation, is usually not less than four feet.

The rotation of use of such a site, variable to meet market and other conditions, is generally as follows: one or two years of water crop (fish and fowl) alternating with one year of grain (wheat or barley). Each crop prepares and improves the soil for the next. This treatment may in places and on occasion be supplemented by small quantities of lime and potash (wood ashes) or phosphate (rock or acid) and nitrates (protein waste from house and barn) to correct accidental deficiencies.

The biological principle involved is that the stubble of grain, the cellulose material and dead leaves and twigs when under water are attacked and eaten by fungi, notably bacteria. Floating in the atmosphere and resting in the soil and other material are dried bodies of plants mingled with which are forms of animal life—infusoria. These and similar organisms become activated in the presence of water, if it is correct in quantity and quality. The end result is aquatic vegetation that is food for fish and fowl, the farmer's water crop. After the pond is drained in the rotation plan, the aquatic vegetation is greedily pastured by the farm animals, while the protein material left behind, including the unutilized bodies of fishes and aquatic animals, becomes transformed into manure for the following grain crop. Because of the regulated biological action incident to the rotation, these ponds are generally free from malaria.

Under favourable natural conditions generally, equal areas yield comparable profits from both land and water farming, and thus are reduced the natural hazards in farm practice.—Reproduced from *Little Waters: A Study of Head-Water Streams and Other Little Waters, Their Uses and Relations to the Land (1935)*, by H. S. Person, E. J. Coil and R. T. Beall, as quoted in *Wild Life Conservation* by Ira N. Gabrielson, Director of the Fish and Wildlife Service, United States Department of the Interior, New York (1942). The Macmillan Company, publishers.

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* Person, H. S., Coil, E. J., and Beall, R. T. *Little Waters: A Study of Head-water Streams and Other Little Waters, Their Uses and Relations to the Land*, pp.65-67 (1935)

INDIA TIDES OVER FOOD CRISIS

'VICTORY in war is much more important than winning a battle. The country has been able to avert a catastrophe on the food front, but difficulties still remain and there must be no slackening of our efforts,' said the Prime Minister, Pandit Nehru, inaugurating a Conference of Provincial Premiers and Food Ministers in New Delhi on April 28. Shri Jairamdas Daulatram, Food Minister, presided.

Ten Premiers and 14 Food Ministers took part in the general discussion on the food situation in various provinces and States. The Conference was unanimous on the need for better organization of railway transport to meet increased demands of grain movements, and for adequate supplies of materials and implements necessary for increasing food production.

Food Minister optimistic

Shri Jairamdas Daulatram addressing the Conference said : ' Our food position is not as bad as some people might imagine. If we maintain our determination to take all the steps that are necessary and expedient to help those parts of the country where supplies are short and prices high, the country will have to face no major crisis on the food front'. Continuing the Food Minister made the following points :

(1) Indian production is nearly 900,000 tons more than last year though the country is still deficit so far as the total needs are concerned.

(2) As a result of various factors, the chances of securing 2,000,000 tons from outside India have definitely improved.

(3) The internal surplus available to the Central Government from the provinces and States would come up to 500,000 tons.

(4) The Government of India have been able to increase their allocation to the deficit areas from 22,00,000 tons to 26,00,000 tons.

(5) Our problems are not solved by the mere knowledge that we have some surplus inside the country and that we can import a good quantity of food grains from other countries. All these lakhs of tons of food have to be secured ' in time ', secured at ' reasonable prices ', stored ' properly ', moved ' quickly ', distributed ' efficiently ' before we will have saved our people from the rigour of less food and higher prices which parts of Madras and Bombay are experiencing.

Food Conference concludes

The Conference concluded its session after considering three reports of the four Sub-Committees appointed. The Sub-Committees dealt with measures to be taken against hoarding, problems of transport, the supply of materials required for increasing agricultural production and the feeding of special classes of people. Various suggestions were made in regard to the report on transport which would be considered by the Government of India. The report of the last Committee will be circulated to the various Governments for eliciting their opinion.

In winding up the proceedings of the Conference, Shri Jairamdas Daulatram said : ' My feelings have been with those areas where the people have not adequate food and funds to meet their requirements. India is one and both our difficulties and favourable circumstances are common property. The main question is the difficulty experienced by certain provinces and States in meeting the day to day requirements of the people. With the cooperation of such parts as have lower prices and probably fair stocks and if we are able to maintain our morale, the country will be able to deal with the situation without any major difficulty. For 30 years we struggled against mighty odds and step by step we came to success. It is that same spirit that must carry us through the present difficult situation in some parts of the country. If the battles for freedom were of a particular nature, the fight against food shortages is not very different. If we have the same feeling of unity and determination we are bound to succeed'.

HYBRID ONIONS

ONIONS are the next crop to feel the effects of hybrid vigour. Onion growing requires a great deal of labour, and a big advantage of the new development will be reduced labour requirements. Hybrid onions make it possible to increase production by as much as 20 to 50 per cent per unit of land which means that less land, and consequently less labour, will be needed for a given quantity of product. (Incidentally, some of the hybrid onions are of mammoth size, the biggest so far weighing 4 pounds apiece). Largescale production of hybrid seed was made possible by several years of breeding to produce onions which cannot pollinate themselves because their pollen is sterile. Thus all that is necessary to insure hybrid seed is to plant alternate rows of a normal onion, which will produce pollen and be the male parent, and a male-sterile onion, which can only receive pollen and will be the female parent. Seed is collected only from the male-sterile plants. The first hybrid onion, released for production in 1944, is adapted only to the South-west. Hybrids of all types for all areas will follow as fast as they can be produced.—From *Report of the Administrator of Agricultural Research*, 1944, United States, Department of Agriculture.

COVER ILLUSTRATION

A close-up of the tractor.

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 7
JULY 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.7.48
2,800

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department, (Publication Branch), India House, Aldwych, London, W.C.2.

INDIAN FARMING

JULY, 1948

Vol. IX No. 7

FRUIT INDUSTRY IN THE INDIAN UNION

THE partitioning of the country has created a series of new problems in the fruit economy of the country. For not only some of the most highly developed centres of fruit production such as Peshawar, Canal Colonies of the West Punjab and Quetta are lost but as many as 203 licensed fruit products establishments including some leading manufacturing concerns have also been lost to Pakistan.

Planning for the fruit industry of India under the changed situation after partition involves, therefore, an entirely different approach to the one already recommended by the National Planning Committee. In the first place, there is now an urgent need to acquire a first hand information in respect of the acreage yield of different varieties of fruits grown in various parts that have seceded from the Union. At present the only authentic source which gives some information on the subject is the annual volume of the *Agricultural Statistics of India* wherein acreage in respect of fruits is combined with that for vegetables and root crops. Moreover, even this source does not give recent figures in respect of Indian States. The correct statistical information which forms the basis of future planning must be made available at all cost.

Based on the available data, out of 41,26,000 combined acreage of fruits and vegetables and root crops in pre-partition India (excluding States) we have lost to Pakistan hardly 20 per cent, but in terms of tonnage and quality and types of certain fruits our losses are many times more. At present the estimated combined acreage left for fruits, vegetables and root crops in the Indian Union Provinces is about 30,78,000 which only forms about 1·7 per cent of the total cultivable area in the Indian Union Provinces, or about an acre for over 75 persons. On conservative estimates to provide for the desirable minimum nutritional quantum of 4 oz. of fruits alone *per capita* per day for the estimated population of the Union Provinces only (23,31,48,000 in 1942), we need over 44 lakhs of acres under fruit crops (presuming approximate yield per acre as 47 md. of fruits and reducing the population as to 80 per cent adult equivalent). But keeping in view the needs of the preservation industry as well as the ever-increasing population our target should be still higher, i.e. about 60 lakhs of acreage under fruits alone. The most disappointing feature of the story is not the under-acreage, but abnormally poor yield and low quality of fruit in the Union Provinces, the general verdict of the technologist in the industry being 'not fit for canning'. This further shows the desirability of improving the efficiency and ability of the fruit growers with a view to build the Indian fruit industry on a sound and solid foundation.

It is admitted, however, that there are great potentialities for increasing fruit production in the Indian Union. The Union enjoys a variety of climates and soils. There are numerous fertile pockets in various provinces which could be developed profitably with the advent of irrigation schemes to increase production of quality fruits and vegetables. There exist numerous horticultural varieties of fruits also. It only requires sorting out of varieties to select finally quality and high yielding strains which could help the Union in augmenting fruit production to compete with any fruit producing country such as Italy, France and California.

It is opportune time to formulate a fruit development policy. Strong organization also is needed to handle the development of fruit industry in a systematic manner. Lack of organization at present is the chief hindrance in the way to step up production. What is needed most, is the creation of regional Horticultural Boards and a Central All-India Horticultural Board on the model of the U.P. Fruit Development Board to act as liaison agencies between the Government and the growers to foster the national fruit industry of the country on sound, scientific and progressive lines.

The pivotal point in formulating the Union policy as regards fruit development lies not only in selecting productive strains of commercial fruits as pointed above, but also devising measures to eliminate waste due to pests and diseases and setting up adequate organizations to conserve the residual production if and when a glut occurs due to lack of transport facilities.

As regards improvement in the quality and yield of fruits very little effort has been made in the Union. Some selection of indigenous fruit crops such as guava and pomegranate have been made in the province of Bombay. Lucknow 49 strain of guava and G.B. No. 1 pomegranate are decidedly superior strains as compared with the local production. There appears to be increasing demand for such strains. Hardly any selection of any other fruit crops is worth noting. Recently, however, an attempt is being made to hybridize mango varieties in the province of Madras. The result of these investigations is yet to be seen. Almost all horticultural workers in the Union have been busy with the testing of varieties and introducing foreign strains. The Union is rich in variety collection and here one can find a nucleus for future development. Several strains of citrus such as, Marsh seedless grapefruit, Eureka lemon, Valencia late, Blood red, Jaffa orange, Malta orange, and numerous varieties of apples such as Baldwin, and Cox's Orange Pippin have been introduced. The introduction of these varieties is undoubtedly a step forward in this field of development.

Incidentally it may be mentioned that quite a useful work is being done in many provinces in testing rootstocks of citrus and apples and also valuable field observations have been made in testing the influence of manure on yield and quality. Research in the method of propagation has, however, not made much headway. This is another profitable field to be exploited.

One of the most important causes of low production of fruit crops is due to the damage to blossom and fruit by pests and diseases. Although entomological and pathological research is forging ahead in several provinces, very little is done by way of finding successful remedies against pests and diseases of fruit crops. Some half-hearted trials here and there have been recorded. But no remedy for fruit fly, citrus die-back, fruit borer, root-rot, cracking of bark and such other diseases are in sight. A concentrated attempt to protect crop and minimize damage is badly needed and this offers a rich field for investigation in the future.

As regards conservation of fruits, a beginning is already made. The Government have declared fruit industry as protected industry. Laws to standardise fruit products and ensure hygienic conditions are already functioning. Protective tariff on imported preserves is also levied from the beginning of this year. All preserved manufacturers are licensed. The Institute of Fruit Technology provides research activities to solve the problems of preservation behind this set up. In spite of all this, however, the industry is not progressing. After a high war boom the production has gone down, due to post-war heavy dumping of American Army surpluses for the civilian markets. The containers are not available. The fruit and vegetable prices are prohibitive. Due to decontrol of sugar the commodity is not available at a cheap rate. One Bombay importer has been offering fruit pulp from Australia at the rate of as. 3 per lb. in 50 lb. tins (2 tins to a case), i.e. about as. 2 per lb. naked. Whereas apple is sold at Rs. 5 per 40 lb. box in New Zealand, it is sold at Rs. 30 per 40 lb. box in this country. Onion is sold at as. 8 a seer. Lemon is sold at Rs. 40 per maund (80 lb.). All fruits are dear. The industry is paralyzed. A critical study of the existing situation of fruit industry convinces one that it is an uphill task to control the various factors affecting the industry.

The first and foremost step to augment production is to survey the entire Union tracts and lay figner on the spots where fruit crops could be easily grown and extension is possible. The next is to set up an organization to make the fruit and vegetable cultivation more economical by making quality and productive strains available for distribution and by providing quick transport to markets. Again in the new set up, the question of establishment of a chain of commercial cold storage plants has yet to be planned. Doubtless cold storage plants have to play a very conspicuous part in avoiding gluts in the market by regulating and extending the period of availability of fruits in different areas and in different seasons. Transport and market will play a great part in increasing production. It is on such lines that the fruit policy must be laid to stimulate production.

Original Articles

MANUFACTURE AND STORAGE OF *GHEE*

By N. N. DASTUR and B. N. BANERJEE

THE production of milk is closely correlated with the quantity and quality of feed given to cattle, for this reason, there is a wide fluctuation in the quantity produced during different seasons. Usually the season for maximum production starts from September, reaches a peak in November and continues till March : the season of lowest production starts from April and lasts till August. When milk is produced in larger quantities than what is required for the use of the local community it is necessary to find some means of preserving it whole or of preserving some of its major constituents or even only one of its least perishable constituents. Under the first category may be cited such products as *khoa*, condensed milk or milk powder. Under the second head will come different varieties of cheeses. *Ghee* will come under the third category. Of all the constituents of milk, *ghee* is the easiest to separate without the use of very complicated machinery : it has comparatively very good keeping quality.

Ghee-*making* : *an ancient industry*

Ghee is the pure fat of milk. Commonly it is made from cow and buffalo milk, but in certain isolated areas *ghee* from goat and sheep milk is also prepared. *Ghee* has occupied a very prominent place in the Indian dairy industry from the earliest times and this is continued even to-day. It is estimated that approximately 58 per cent of the milk produced in our country, totalling nearly 3,589 lakh maunds, is utilized for making *ghee*. The value of *ghee* produced was over 100 crore of rupees per year in pre-war days. *Ghee* that is produced in the country is to a very large extent consumed in the country. The quantity produced, though so huge, is the joint effort of every tiny village. Any improvement or defect that may be consciously or unconsciously introduced will thus have a profound significance both on the final value of *ghee* and its market value. Even though various other fats, like vegetable oils and hydrogenated vegetable oils, are available in large quantities and at a much lower cost, the demand for *ghee* continues to increase. It is thus in everybody's interest that the best quality of *ghee* be produced. *Ghee* production as mentioned above has been practised from the earliest times and it is not a matter of wonder that during that time bad practices as well as good have entered into the routine of manufacture. It is the intention of this article to analyze in the light of science, such step in the process of *ghee*-making so that the bad ones may be omitted or changed and the good ones confirmed or introduced, the ultimate object in either case being the production of only the best quality of *ghee*.

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Isolation of ghee

Ghee can be isolated from milk by various methods. No one method can be described as the best but, if certain precautions are observed, good *ghee* can be produced by any of them. The different methods followed to-day in the country may be summarized as follows :

1. Desi *method* : Milk is converted into curds, butter is isolated and this is heated to obtain *ghee*. This method is most widely used.
2. *Creamery butter method* (*Mukhan ghee*) : Cream is obtained from milk by the use of mechanical separators. Butter is prepared from this cream after souring and then it is melted to *ghee*.
3. *Cream method :* Thick cream is prepared by the use of mechanical separators and, after souring, is heated directly and *ghee* is obtained.
4. *Vacuum pan method :* Creamery butter or thick cream is freed from water by heating

under vacuum at a low temperature till pure butterfat is obtained.

5. *Direct from milk:* This is prepared by churning cooled milk after heating it first. This method is used only in rare instances and hence is not of commercial importance.

Under each of the above heads many modifications are practised, e.g. in the *desi* method raw or boiled milk may be used; curds of various degrees of acidity may be prepared; the butter obtained may be stored or at once converted into *ghee; ghee* may be first kept as *kacha ghee* and then made into *pucca ghee;* and so on. The modifications are adopted as are best suited to the local conditions and the market demand. However, if *ghee* of uniformly high quality, i.e. having good keeping quality and retaining all its nutritional factors, is to be produced throughout the country, it will be necessary to modify the methods to some degree. To understand why these modifications are necessary it would be best to understand first the various factors which may contribute to the spoilage of *ghee.*

Spoilage of ghee

A chemical examination of *ghee* reveals that it contains about twenty-two different fatty acids which are held in combination with glycerine. A fresh sample of *ghee* will not contain any free fatty acids. This combination can however be broken up fairly easily by giving favourable natural conditions during storage, e.g. presence of oxygen, light, moisture, etc. When this takes place *ghee* begins to go bad. The same result can be brought about artificially, for example, by the addition of any alkali when the acids are detached from glycerine and soaps are formed. Further, the process of decomposition is catalytic, i.e. once the decomposition has started the products of decomposition further help to decompose good *ghee.* It will, therefore, be readily understood that care must be exercised at every step and any neglect at one point may spoil the whole product. It is extremely difficult to arrest the decomposition process once it has started. Besides glycerine and fatty acids, *ghee* contains other valuable substances in minute quantities like carotene, vitamin A, etc. which are important not only from the nutritive point of view but also because of their property of imparting additional stability to *ghee.* In *ghee* that is decomposing, these substances are destroyed or converted into entirely different products which do not have any useful purpose.

The spoilage in *ghee* may broadly be divided into two groups—(A) development of free fatty acids and (B) development of rancidity. Each of these will be discussed in detail below.

(A) *Development of free fatty acids in* ghee

Ghee that is prepared under clean conditions and stored carefully will not have more than 0·2 to 0·5 per cent of free fatty acids, expressed as oleic acid. This ideal is seldom realized in market *ghee. Agmark* standards allow a free fatty acid content to the extent of 2·5 per cent. In spite of this liberal limit, market *ghee* samples often have an acidity of 8 to 10 per cent, and occasionally such high figures as 19 to 20 per cent oleic acid have also been noted. It is doubtful if *ghee* with such degree of acidity should at all be classed as *ghee* and this state of affairs is a severe reflection on all concerned. This will become all the more impressive if it is realized that *vanaspati,* a product that is considered much inferior to *ghee,* is allowed to have only 0·2 per cent of free fatty acids.

The main factors which contribute to the development of free fatty acids are undesirable micro-organisms, lipase and moisture.

Micro-organism: Certain types of micro-organisms are known to break up butter-fat rapidly. These organisms are not originally present in milk but gain access through atmospheric contamination, the use of unclean water, and unclean vessels. Having once got access to milk, curds or butter, they multiply very rapidly and secrete a substance called lipase, which is a fat-splitting enzyme. It is a common practice to use raw milk for preparing curds. This is most undesirable and accounts for nearly 50 per cent of the defects found in market *ghee.* If milk is boiled, i.e. brought to first boil and simmered for five minutes, it will destroy almost all the organisms. This milk, after cooling, should be inoculated with a good starter. A rough method of judging whether the starter is of desirable quality is to observe its consistency and flavour. Good starter, formed by the presence of lactic acid organisms, will be solid in consistency with the separation of little whey at the top of the whole mass. A bad starter will not be a solid mass, but will be in two layers, curd at the top and a thick layer of whey at the bottom, and will be full of gas holes. A good starter added to milk brings about coagulation of milk by the development of lactic acid organisms. These organisms tend to preserve the curd against the intrusion of undesirable organisms from the atmosphere. If the milk is not boiled before curdling, there will be a large number of fat-splitting organisms and the lactic acid bacteria are unable to exercise their full prophylactic effect.

The usual type of containers used for storing milk and milk products are porous and these pores will serve as an ideal hiding place for bacteria. It is desirable that after cleaning the vessels with mud and rinsing with water, they should be sterilized by filling three-fourths with water and bringing to boil, preferably after covering the pot with a lid. Vessels not thus sterilized are a good source of contamination, especially when raw milk is kept for souring.

Lipase: The enzyme lipase is always present in milk and is known to be a great source of trouble to the dairy industry. It is soluble in *ghee* and hence if not destroyed will always be associated with *ghee* at all stages of production. The best and the easiest means of getting rid of lipase is to boil the milk as suggested. In unboiled milk this natural lipase is further augmented by the lipase produced by micro-organisms when very old or unclean culture is used for inoculating fresh milk.

Moisture: The presence of water or butter-milk increases the development of acidity in *ghee.* Butter should, therefore, be stored for as short an interval as possible. The presence of butter-milk also serves as a source for bacterial contamination. Compared to the presence of butter-milk, water alone is less harmful. It is, therefore, essential that butter should be given at least one and preferably two washings with clean water, especially if the butter is not to be melted into *ghee* at once.

The following results illustrate the development of acidity in butter and *ghee* that takes place under different conditions. For results shown in Fig. 1, *ghee* was prepared from the same batch of cow milk, a part of which was boiled and the other part used in the raw state. The curd was soured for two, four, six and eight days respectively and then churned into butter. The acidity of butter was determined and is illustrated in Fig. 1.

It will be noticed that butter made from raw milk curds develops acidity nearly two and a half times as rapidly as similar butter obtained from boiled milk curds. When this butter with initial high acidity is stored, there is a further development in the acidity as is illustrated in Fig. 2. On the other hand butter made from boiled milk shows very little acidity. This shows that much harm is done by storing butter and it should be converted to *ghee* as early as possible.

As it is necessary to boil butter to *ghee* as rapidly as necessary, it is equally necessary not to store the curds for any length of time but to quickly churn out the butter and convert the latter into *ghee.* Fig. 3 illustrates the effect of storing curds. It will be seen that with raw milk curds, the acidity in *ghee* keeps on rising the longer the curds are stored. Boiling milk initially safeguards any spoilage and *ghee* of very low acidity is obtained even if for some reasons it is found necessary to keep the curds. Thus by using boiled milk a reasonable safeguard can be provided for obtaining a good *ghee* at the end.

(B) *Development of rancidity in* ghee

Rancidity is quite a distinct phenomenon from development of acidity. A sample of *ghee* may have high rancidity but still will have low acidity. On the other hand a sample of high acid *ghee* is very likely to have high rancidity also. There are many factors which are responsible for the development of rancidity, the chief of which are air, light, heat and certain metals. Fats normally contain certain properties of resisting the onset of rancidity but once this resistance is destroyed rancidity will develop very rapidly. A sample of *ghee* with high acidity may pass unnoticed by taste and odour but development of rancidity even in initial stages, will be easily detected organoleptically. *Ghee* prepared under best conditions will develop rancidity if stored under bad conditions. *Ghee* should be kept away from *air* which contains oxygen. As far as possible use of porous pots should be avoided. Glazed pots, porcelain jars, aluminium pots, tinned containers are the best for storage. These containers are impervious both to air and light. When *ghee* is to be stored, the container should be filled right to the top so as not to leave a big air gap which will supply oxygen for the development of rancidity. Hot

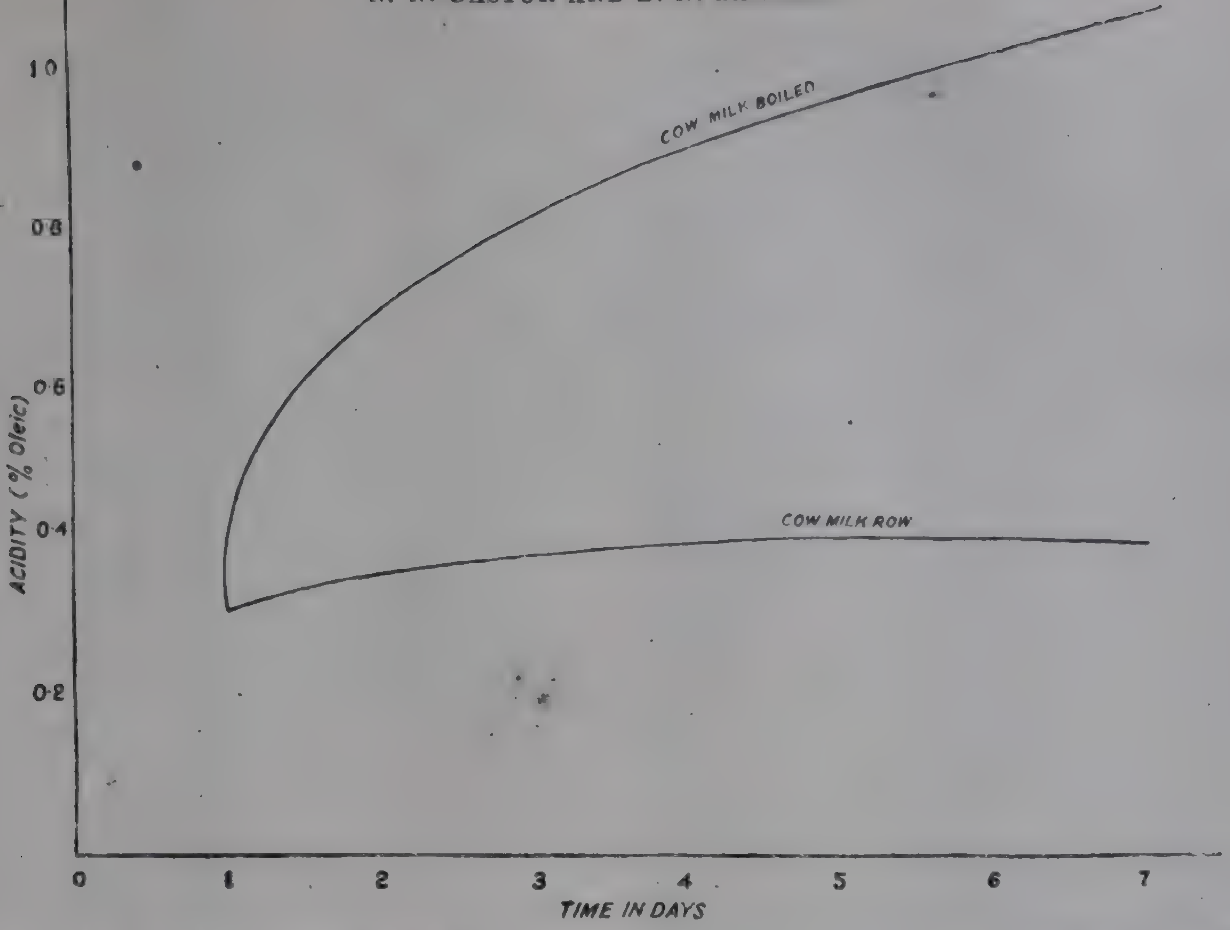

FIG. 1. The effect of using raw and boiled milks on the development of acidity in butter

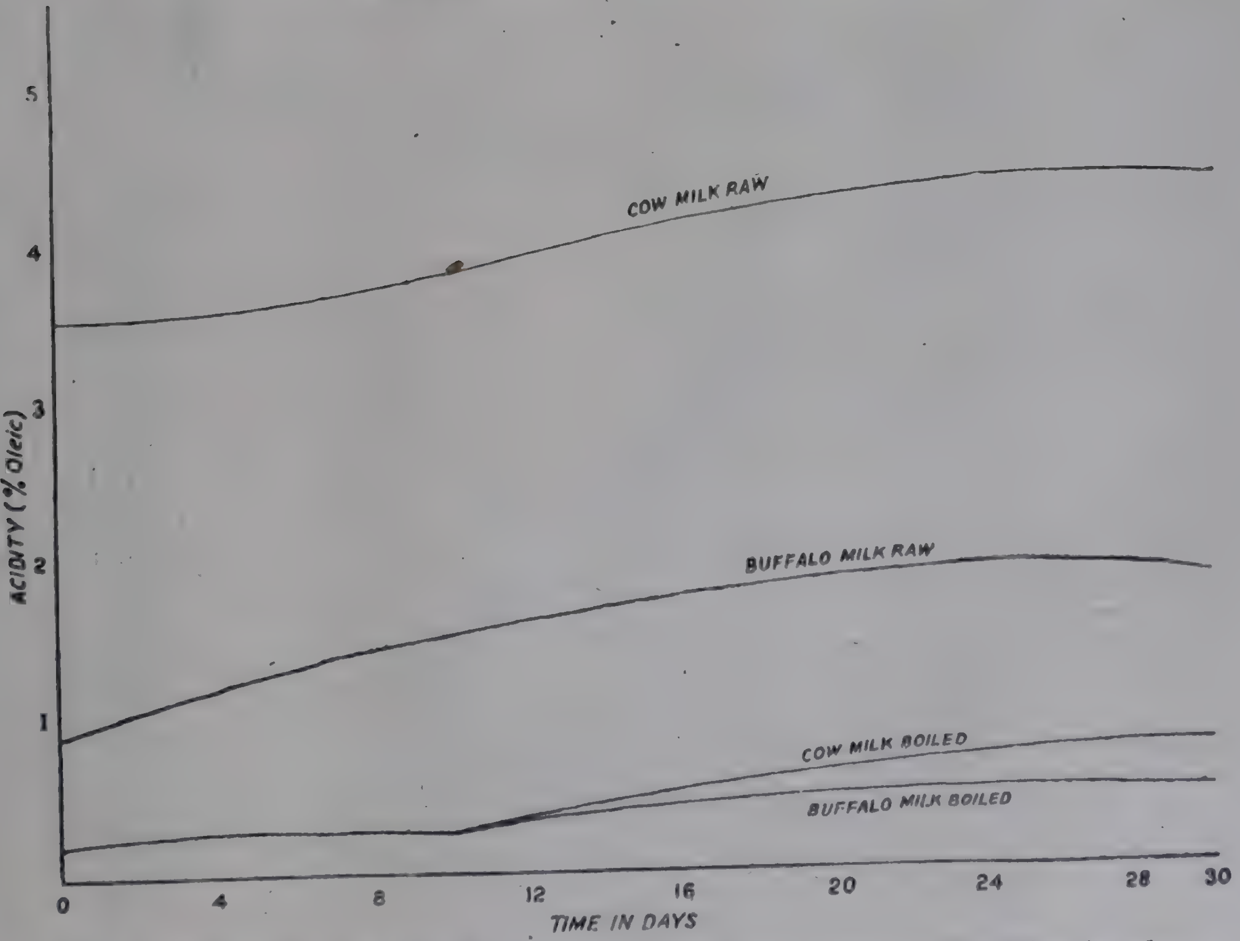

FIG. 2. The effect of storing butter on the development of acidity in *ghee*.

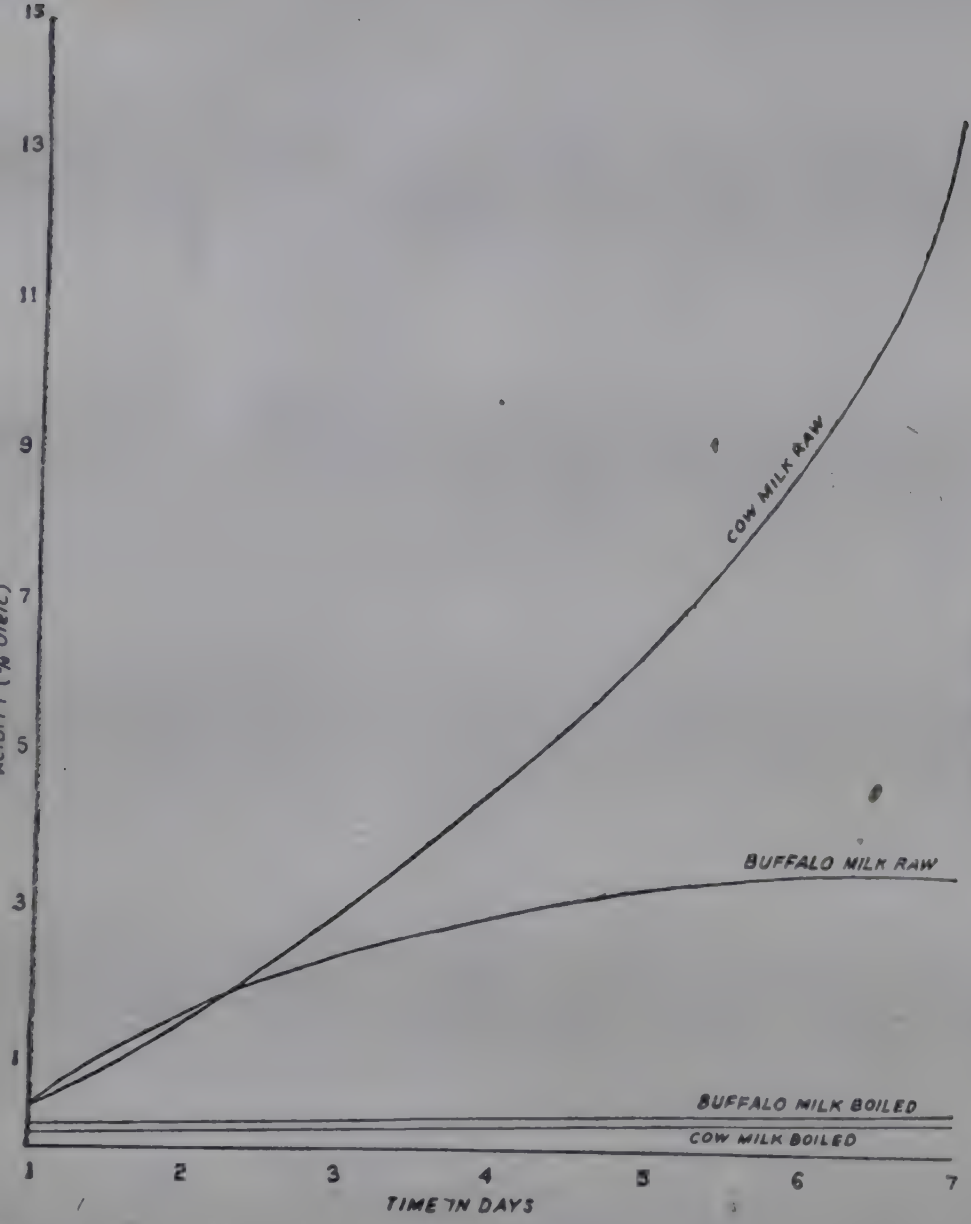

FIG. 3. The effect of storing curds on the development of acidity in *ghee*.

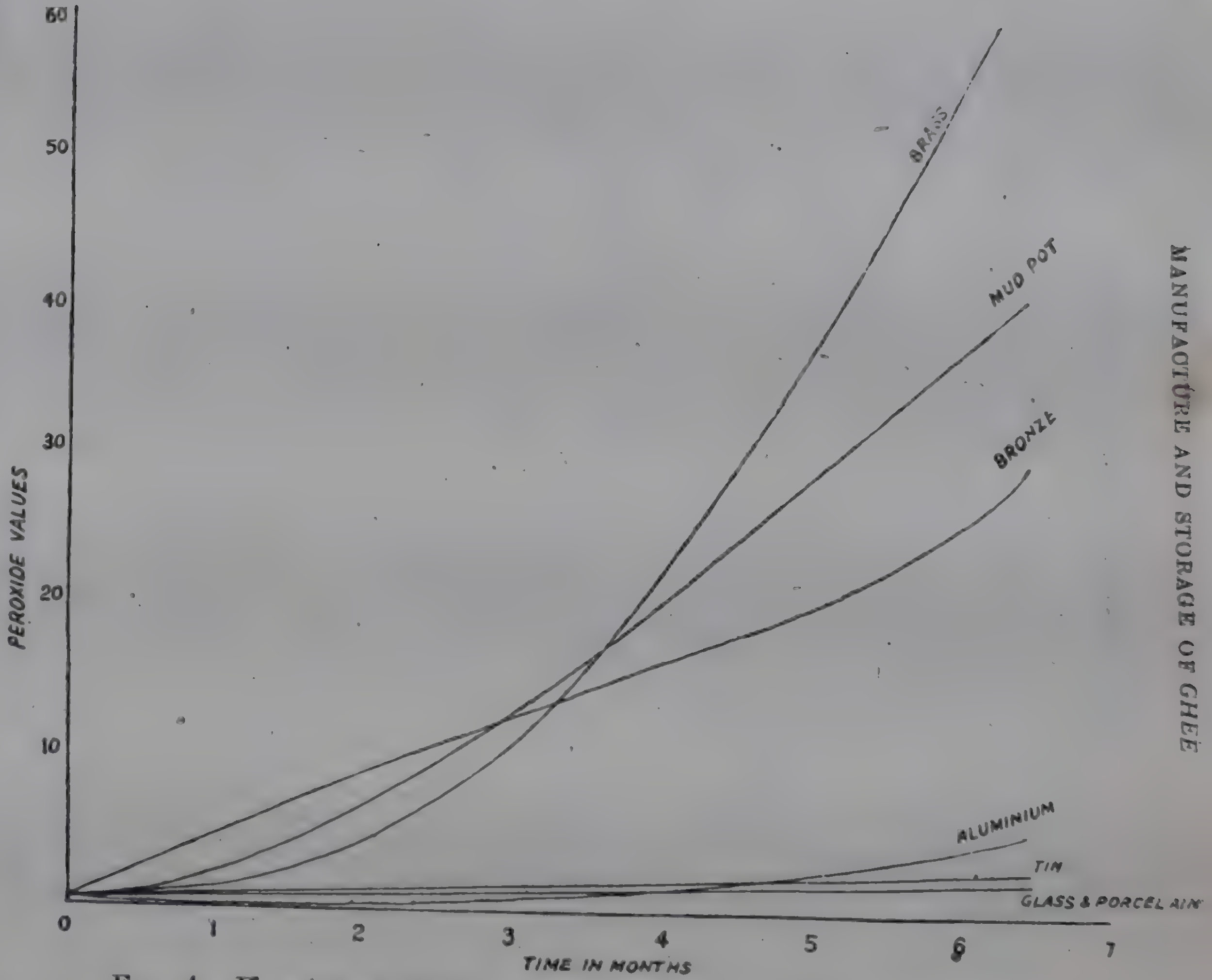

FIG. 4. Keeping quality of *ghee* stored in different containers.

ghee should not be left open exposed to air. Light is a very powerful agent in developing rancidity. Open *ghee* tins should not be kept exposed to light. The place where *ghee* is prepared or packed should be well-shaded. The action of light is rather persistent. The rancidity does not develop at once but once it has been initiated, though only in a very small measure, the *ghee* will go bad even though stored afterwards in closed containers. Certain metals act as powerful catalysts for the development of rancidity when present in very small quantities. Iron and copper are the chief amongst those which are likely to be encountered in everyday practice. Use of brass and bronze vessels which contain copper should be avoided not only for storing *ghee* but also for keeping milk which is to be used for preparing butter or *ghee*. If they are used, they should be heavily tinned. Tin cans with any rusty spots should not be used for storing *ghee* at any stage.

In Fig. 4 is shown the effect of different types of containers on the keeping quality of *ghee* stored in these as measured by the peroxide value.

It will be noticed that *ghee* stored in glass bottles, glazed porcelain jars, tin cans and aluminium vessels keeps good for a long time without showing high rancidity. The use of such containers both under household and trade conditions is recommended. A word may be added about glass. Glass, apart from being fragile, allows light to pass through and hence its use should be discouraged.

Undesirable factors in actual practice

Having studied the theoretical causes of the spoilage of *ghee*, it may be well to enumerate here from actual practice instances wherein undesirable factors do come into play. In some parts of the country raw milk is regularly used and soured in porous mud-pots with old butter-milk. All these conditions favour contamination with undesirable strains of bacteria which break up *ghee* into free fatty acids. In these circumstances *ghee* is exposed to ideal conditions to go bad and develop high acidity. Curds are sometimes churned in naked brass pots. Brass contains copper which easily goes into solution under the influence of acid contained in curds and butter-milk. This copper, though in very minute quantity, will be carried along with the *ghee* at all the subsequent stages and enhance the rate of spoilage. If churning is carried out in the open, the butter may get contaminated with dust particles which may be carrying undesirable bacteria. Further, light is a very powerful agent in developing rancidity and when churning is done in the open, butter may be unduly exposed to light. The butter in many instances is not given any washing with water. The butter-milk carried along with the butter provides a very favourable source of infection and medium for the further development of micro-organisms. Butter should always be given one or two washings with clean water. Butter obtained should not be placed very near the kitchen fire as high temperature greatly reduces the keeping quality of the *ghee* prepared.

Butter is usually melted first into *kacha ghee*. This *ghee* contains quite a good deal of butter-milk. Such *ghee*, when stored in kerosene tins, which are usually old ones, starts attacking the tin. The iron that goes in solution induces greater spoilage than copper does. In many instances the tins are not properly covered. They are plugged either with rags or covered with dry banana leaves, etc. and thus *ghee* is freely exposed to the atmospheric oxygen. *Kacha ghee* is then passed on to the village merchants. The containers used for collection also suffer from the same defects as mentioned above. Further, this *kacha ghee* when it reaches the town merchants is stored for an indefinite time till required for the market. The practice of producing *kacha ghee* requires to be discouraged; but, if at all it is produced, care should be taken to melt it and bring it up to the final stage as early as possible, i.e. within about a month. For remelting *kacha ghee*, the tins of *ghee* are kept round a fire to melt the contents which are stirred from time to time with a naked iron rod. The *ghee* is usually transferred to iron *karais*. When the day's work is over, the normal practice is to wipe out the *karais* with old gunny bags. As a result, most of these vessels have a heavy lining of old *ghee* on which new *ghee* is poured. The refined *ghee* is packed in tins which are not quite new. Sometimes in order to recover as much *ghee* as possible, the *ghee* residue is exposed to direct sunlight when, due to the heat of the sun, a little more *ghee* comes out. The *ghee* is mixed with the amount already collected. As explained, light is a powerful auto-catalyst and once the *ghee* is exposed to light the deterioration progresses readily even after the tins are filled.

The temperature to which *ghee* is exposed before final packing varies widely. In western India it is usually melted to 70° C. and then allowed to settle for about two hours. By this process most of the moisture and other impurities will be removed. If carefully carried out, this method will no doubt give good *ghee*; and it has the added advantage of imparting lactic flavour which is liked by certain classes of people. In other parts of the country *ghee* is melted to much higher temperatures ranging from 100° to 120° C. The process of heating must be carried out slowly so as to give time for moisture to escape and the temperature should not be raised too suddenly. Sometimes it happens that heating is carried out to an excessive degree, temperature going up as high as 150°C. This is very undesirable because *ghee* loses its vitamin A content very rapidly when the temperature goes above 120°C. At 120°C. the residue at the bottom, which is composed of casein, will just begin to go brown but it should not become dark brown.

Methods of obtaining good ghee

We shall now proceed to describe how good *ghee* can be obtained by different methods. As mentioned before each method is capable of giving good *ghee* and should be selected as per facilities available. Special features of each method will be described under each method.

Desi *method:* The recovery of *ghee* by this method is not good. As high as 15 per cent of butter-fat may be left in the butter-milk. This is the most widely followed process and if the butter-milk that is produced is consumed entirely by the producers, it cannot be considered as loss. All the appliances are procurable under village conditions and the method yields a by-product the disposal of which is not a problem. This method is ideally suited for small producers but cannot be applied on a factory scale.

Milk to be used for the preparation of *ghee* should be brought to boil and simmered for five minutes. The vessel used should be clean and if mud pots are used, they should be sterilized by boiling water in them. Naked brass and bronze vessels should not be used. After the milk is cooled, a little of a good quality *dahi* should be added and the milk allowed to curdle. For getting this seed culture it is preferable not to use previous samples of *dahi* or butter-milk, but a small quantity of *dahi* should be prepared in another vessel using only boiled milk. When adding the seed care should be taken that it is compact and has agreeable odour. If there is a separation of whey at the bottom or there are gas holes, this culture should be discarded.

After allowing the curd to stand for say 24 hours, it should be churned, either in the same vessel or by transferring it to a larger vessel with the desired amount of clean water. This vessel should also be cleaned as described above. The paddles used for churning should be made from good wood and should not contain any nails or other iron connection. Butter-milk will easily take up minute quantities of metals which will react adversely on the keeping quality of *ghee*. The churning should be carried out in shade, avoiding direct sunlight as far as possible. Preferably the ground where churning is carried out should be watered to avoid contamination with dust.

The butter should not be over-churned and when ready should be given one or two washings with clean and cold water. It is advisable to convert this butter at once into *ghee*. If for some reason this cannot be done, the butter should be dipped in clean cold water and preserved in a closed vessel. The water should be changed as least once in a day. The storage period should not exceed three days at the most.

For melting butter into *ghee* a clean vessel should be selected. The stirrer should be either of aluminium or some tinned metal. It is preferable to make *pucca ghee* at once, instead of first making *kacha ghee*, and further heating it later. When it is not desired to make *pucca ghee*, butter after melting should be allowed to stand sufficiently long to allow *ghee* to separate out. When transferring *ghee* to the vessel in which it is to be stored, care should be taken not to allow any bottom aqueous layer to pass. *Ghee* should be stored in good tins, aluminium vessels or tinned brass vessels with good lids and kept in a cool place. As far as possible the vessel should be filled right to the top to give as little air space as possible. If *ghee* is required for daily use, the required quantity that will last for three or four days should be taken out in a smaller container so that the whole bulk of *ghee* does not come in contact with air often.

Sometimes *ghee* is not directly made into *pucca* for the fear that it will lose its flavour before it is sold. This is quite true if during storage *ghee* is exposed to air, rusty spots and other destructive agencies. *Ghee* that is well-prepared and carefully stored can be preserved without any fear of rapid deterioration. Containers, in which *ghee* is stored, should not be exposed to direct sunlight.

Creamery butter method : This method is adoptable under factory conditions because the volume of products to be dealt with is small. To recover *ghee* from 100 lb. of milk containing 5 per cent fat, only 12 lb. of cream will have to be handled, whilst in the *desi* method all the 100 lb. of milk will require to be stored. The method requires special appliances like a cream separator, a butter churn, butter worker, etc. It can thus be adopted by moderately big producers and it is expected that the process will be carried out under more hygienic conditions as all the necessary facilities are available. The process yields separated milk as a by-product. This is not relished to the same extent as butter-milk by human beings. Sometimes it is given to cattle but it is also very often wasted. This separated milk contains two valuable constituents of considerable commercial value, viz. casein and lactose. Casein is sometimes recovered but the method used is so crude that the sale of the product obtained barely covers the cost of production. Lactose is not recovered. The advantage of the creamery butter process will only become evident when people learn to utilize the separated milk properly.

Fresh milk should be used for separation. For maximum efficiency the temperature of the milk should be near about that of the animal body (110° F.). The cream screw should be so adjusted as to give about 40 per cent fat in the cream. This fresh cream should be pasteurized by heating it to 145° to 160° F. and holding it at that temperature for 30 minutes and afterwards cooling it to below 45° F. ; or heating it to 180° F. or above for five seconds and then quickly cooling it to 45° F. Pasteurization ensures complete destruction of all undesirable micro-organisms, thus assuring a better keeping quality both for butter and *ghee.* This cream is inoculated with a clean healthy starter as mentioned under the *desi* method and allowed to ripen for about 12 hours at 40 to 50° F. The cream is churned after diluting to the desired consistency. The butter obtained is given two washings with clean water. Over-churning and over-working should be avoided as they tend to make butter soft and 'greasy'. If cold water is used, butter with a moisture content of 16 per cent can easily be obtained. Butter to be used for making *ghee* should not be salted.

Butter obtained should be melted into *ghee* as outlined under the *desi* method above.

Cream ghee : The preparation of butter by the creamery process and then melting it to *ghee* is a lengthy process requiring extra equipment and labour. The process can be shortened, reducing the cost of production at the same time, by directly heating cream to obtain *ghee.* The method then becomes greatly simplified and can be used even by small individual producers. *Ghee* of good quality is obtained and the process may be adopted both for small and largescale production. As cream is directly melted into *ghee*, the chances of its contact with water, etc. are considerably reduced enhancing the quality thereby.

Fresh milk is separated in a cream separator adjusted to give high percentage of fat (at least 60 per cent). For ease of separation milk is heated to about 100° F. before passing through the separator. The cream obtained is diluted with twice the amount of clean water and reseparated. This reseparation helps to remove most of the casein and other impurities. This process facilitates quicker separation of the fat and also minimizes the loss of *ghee* by reducing the quantity of *matha.* The cream obtained is inoculated with a good culture and soured for 6 to 8 hours at a temperature of about 50° F. The cream is then melted into *ghee* as outlined under the *desi* method described before.

To obtain *ghee* naturally more fuel will be required but this increase in cost will be amply compensated by saving in the cost of equipment, labour charges and improved quality of *ghee.* When heating cream, the vessel used should be bigger than that normally used for melting butter as there is a tendency to foam. Heating should be carried out on a steady, non-smoky fire, with frequent stirring.

Blending of ghee : Almost all the *ghee* that is produced under village conditions is brought to urban centres and blended. This is carried out with a view to attain three objectives : (a) to get rid of any impurity in *kacha ghee*, (b) to obtain *ghee* of a uniform quality acceptable to local market conditions and conforming to local legal specifications, and (c) to repack loose *ghee* in proper tins.

This type of work is naturally carried out by merchants with substantial means. Still it is regrettable that in most cases the work is carried out under very crude conditions and leaves scope for much improvement. The packing centres are housed in old buildings sometimes without a proper roof. Melting is carried out in big iron *karais* which are not tinned, nor cleaned with soda and water at the completion of each day's work. When the days' work is over, these are left uncovered and in the morning just wiped with some old gunny bags. When *ghee* is put in, these *karais* are never covered but are left open exposed to light with every possibility of being contaminated with dust. Bare hands are freely dipped in *ghee* to judge the temperature. Persons attending to this work are not provided with clean clothes and the nature of the work is such that clothes get soiled easily.

The tins used for packing *ghee* are not always new. They are usually used *ghee* or *vanaspati* tins which are not given a thorough washing with soda and water. After *ghee* is transferred to these, they are left overnight in the open to cool slowly.

It is thus evident that there is a considerable scope for improvement in our present methods of handling *ghee*. What is important for the *ghee* merchants is to realize that they are dealing with a very delicate product which can meet certain nutritional requirements of the nation if elementary care is exercised. It is no exaggeration to state that at present the public at large is very sceptical about the quality of market *ghee* and if this state of affairs continues they will look more and more to other sources for fats. *Ghee* is sold at a high cost and naturally the public expects it to be superior to other fats like vegetable oils and *vanaspati*. Hence every special effort should be made to carry out blending with the best quality of raw *ghee* under most hygienic conditions.

It should be insisted that *kacha ghee* also should be brought only in new tins. This *ghee* should be melted and packed for market without delay. The refining should be carried out in a specially constructed building with cement roof and floor and inlaid with white tiles on the sides. Every care should be taken to exclude flies. The room should be well-ventilated and sufficiently lighted without any sunlight entering in directly. The vessels used for melting *ghee* should be heavily tinned. For melting it is better to use steam-jacketed pans with lids. If *ghee* is to be refined by the sedimentation process, the vessels used for melting should be preferably of a cylindrical shape with a tap about six inches away from the bottom. After melting, *ghee* should be maintained for 2 to 3 hours at 60°C. to allow all moisture to settle out. If *ghee* is recovered by the boiling process, shallower pans will be more convenient as they allow the moisture to escape rapidly. The temperature of boiling should never exceed 115° C. A tap should be provided three inches away from the bottom; and the residue settles down below this level when the *ghee* is allowed to cool. This *ghee* should be then filled directly into new tins which have been given a good washing with soda and water. After filling the tins to a height of about six-eighth, loose lids should be put and the mass allowed to cool down over-night. Next day fresh *ghee* should be added to fill the tins completely and then they should be soldered. These tins should then be stored in a cool place. It is advisable to have special rooms for this purpose which can be maintained at a lower temperature. The present practice of marketing *ghee* only in bulk packings should be extended by the use of smaller packs so that *ghee* is not sold loose and is thus protected completely from the time it leaves the refinery till it reaches the consumers. As a means of guiding the public it would be better if the *ghee* trade by common consent uses tins of a particular shape, say rectangular, which may be easily distinguished from the tins used for selling other edible fats.

In India there are a few refineries which do tend to approach the ideal conditions laid down above. What is now required is the multiplication of such places all over the country. It is hoped that at no distant future, before licensing a *ghee* packing station, it will be insisted that it fulfils certain minimum requirements.

The illustrations inserted (Figs. 5-8) have been taken from one such modern factory. Fig. 5 demonstrates the arrangements for

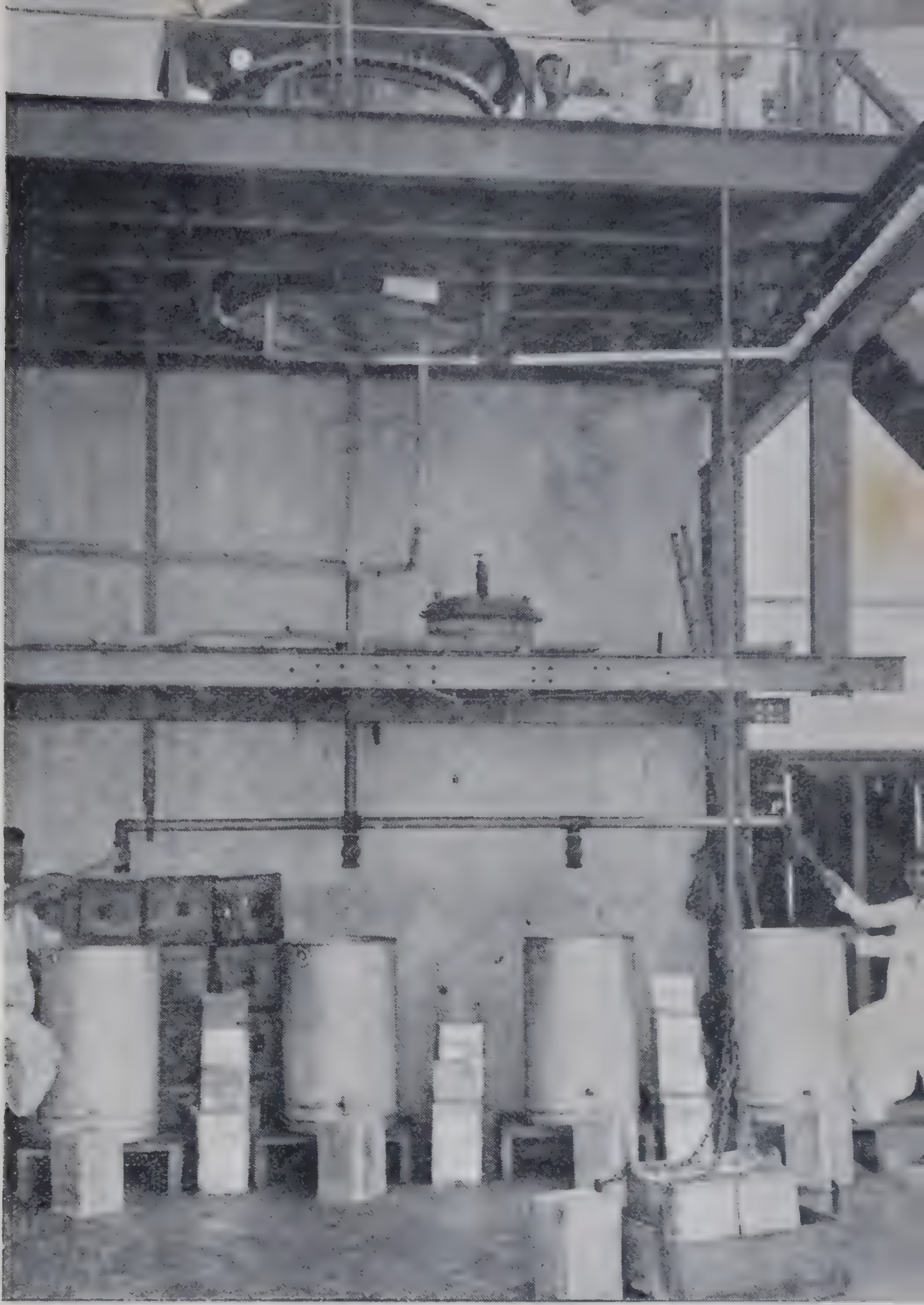

FIG. 5. Arrangement for melting *ghee.*

FIG. 6. An assembly line for packing butter tins.

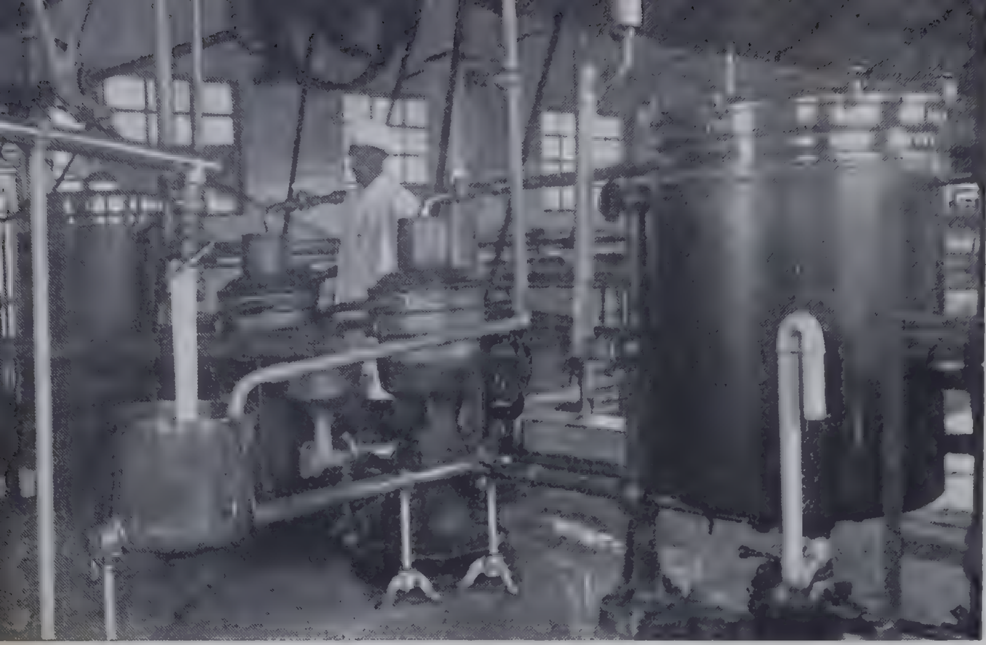

FIG. 7. Direct cream process as worked under factory conditions.

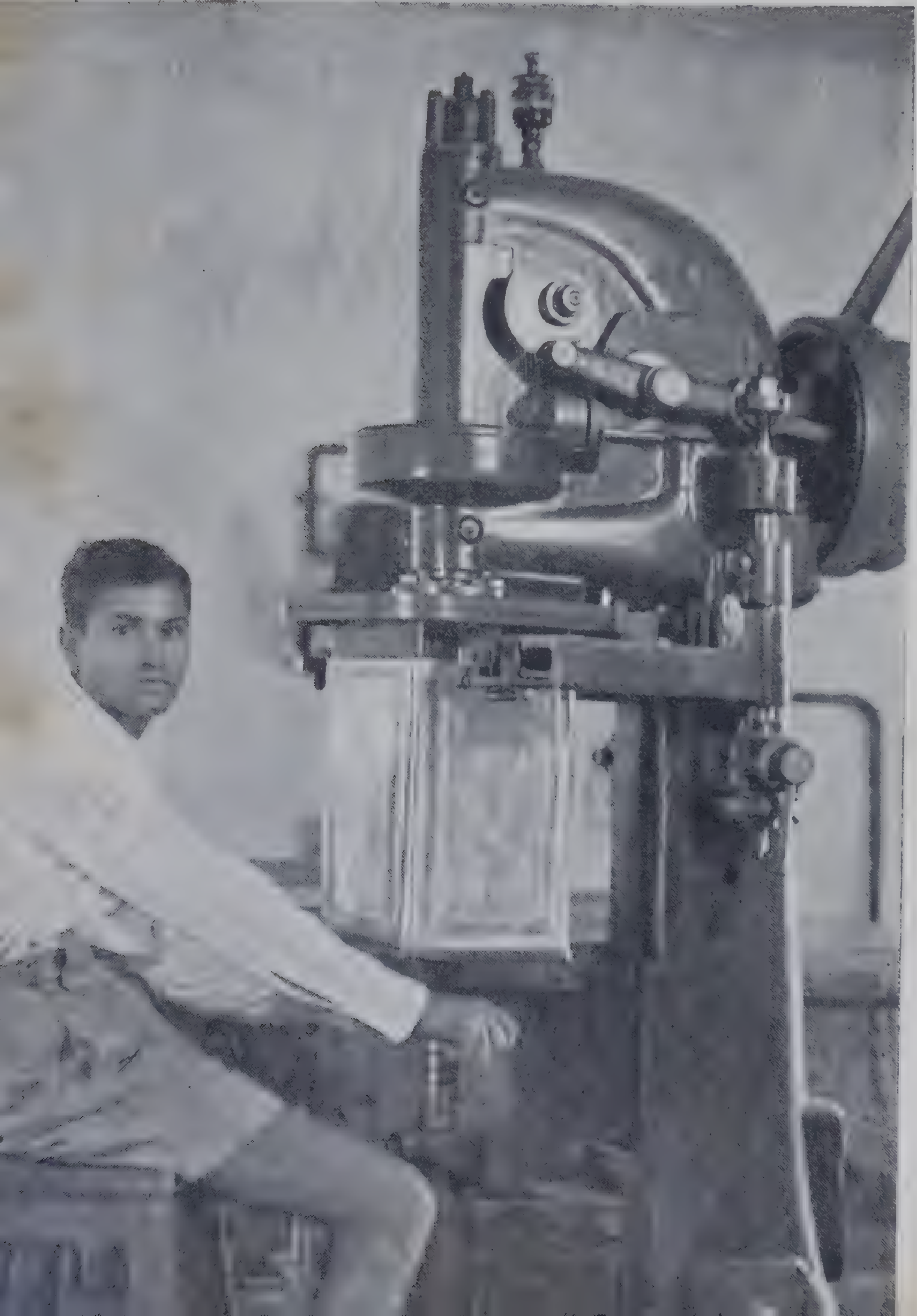

FIG. 8. A seaming machine in action.

melting *ghee*; heating is carried out by steam and then *ghee* is allowed to flow by gravity into settling tanks. The tanks are heavily tinned. From these tanks *ghee* flows directly into tins. The whole building is made of concrete thus ensuring ease of cleaning.

Fig. 6 shows a seaming machine in action; by the use of such machines any possibility of hand contact is avoided. Now-a-days cheap small hand-seaming machines are available which can be used for packing tins of smaller sizes. Fig. 7 shows an assembly line for packing butter tins. Similar arrangement for small packs of *ghee* will mean rapid and clean work. Fig. 8 shows how the direct cream process can be worked under factory conditions for obtaining *ghee*; it illustrates a series of milk separators. The thick cream obtained can be heated directly in open pans or under closed vacuum pans. The system of heating cream or butter under vacuum to obtain *ghee* has recently been developed in New Zealand and Australia and the process can be applied under Indian conditions without any difficulty. It is desirable to develop factory method of producing *ghee*, starting from the initial cream or even milk stage. This alone will ensure an uniformly high quality for the product and incidently lower the cost of production.

From the text it will be evident that the preparation of good *ghee* does not require very special skill. Use of plain common sense will solve nearly half the troubles encountered at present before *ghee* is finally put on the market. The first essential is cleanliness in the method of preparation and storage. The second essential is protection against the destructive action of air, light, water and micro-organisms. Both these can be achieved by simple means as explained before if everybody concerned is willing to play his or her part. Every care should be taken in the preparation of a product like *ghee*, which is so highly prized by all consumers and which gives good returns to the producers. Preparation of good *ghee* is so simple that the same results can be obtained both by small producers as well as largescale factory owners.

When describing the methods of preparation of *ghee*, a word about its adulteration will not be out of place. Natural *ghee* no doubt varies a great deal in its composition and hence people are tempted to resort to adulteration. The methods of detecting adulteration have now been so perfected that adulteration even with 5 per cent of vegetable oils and *vanaspati* can easily be detected. With such sensitive methods available for detection any resort to malpractices undermines the confidence of the public and should never be resorted to.

In the past great importance has been attached to such physical properties as grain structure or colour or flavour of *ghee*. These properties have no doubt their value as giving a quick indication of the quality but they should never be regarded as the sole criteria, as they are subject to artificial manipulation. *Ghee* enjoys superiority over most of the other natural fats because of its vitamin A and carotene content. In no other respect has *ghee* been proved to be superior to other common edible fats. Hence, it is to be expected that *ghee* coming to the market and when delivered to the consumers should have a minimum quantity of vitamin A content. Unfortunately our present legal standards do not take into account this important nutritive property of *ghee*, but it is suggested that the *ghee* trade itself should take a lead in the matter to assure the consumers the quality of their product. A minimum quantity of vitamin that should be present in *ghee* should be laid down. The presence of natural vitamin A will also assure that the *ghee* has been prepared and stored under proper conditions and is fresh. Now-a-days artificial products like margarine are expected to contain a specified amount of vitamins A and D and so the above proposal cannot be regarded as too severe. On the other hand most of the samples of *ghee* bought in the market hardly contain any vitamin A.

It has also been reported that the development of acidity in *ghee* is a controllable factor. There is, therefore, no justification for any high acid *ghee* appearing on the market. It is preferable that normally *ghee* should not contain more than 1 per cent oleic acid, but in exceptional cases this may be extended to 2 per cent. The present tendency of allowing a liberal margin for free fatty acids is to be deprecated: there is no justification for such lax standards.

The composition of *ghee* can be varied by several factors. The most important of these is feed. By adjusting the quantity and quality of food of the animals, *ghee* of any desired consistency can be produced. It is well-known that during certain seasons of the year *ghee* produced in certain areas shows wide fluctuations in composition. This is attributable to feed. It is customary to feed oilseeds or oilcakes when available in very excessive amounts and this upsets the normal composition of secreted fat. *Ghee* obtained from such sources fails to come up to legal specifications and as a remedy it is customary to allow special grades for different areas. This opens up possibilities of adulteration by unscrupulous dealers. The best course would be to teach the primary producers to balance the feed given to the cattle all round the year. Then only *ghee* of uniform quality will be produced without any difficulty. If *ghee* below standard legal specifications is produced, it would be in the interest of everybody concerned to restrict its sale to the particular area of production. It would be best, however, to undertake all measures to avoid the production of such *ghee*.

Finally, 'dos' and 'don'ts' about good *ghee* production are summarized below :

1. Use only boiled milk.
2. Use clean vessels for storing milk, butter and *ghee*.
3. Use a clean, healthy starter.
4. Always wash the butter with clean water to remove butter-milk.
5. Do not make *kacha ghee*. Remove all moisture and *matha* from *ghee* before storing.
6. Store *ghee* in new tins, porcelain jars or aluminium containers.
7. Do not use naked iron vessels for heating *ghee*.
8. Do not leave a big air-gap in the container when storing *ghee*.
9. Do not expose *ghee* to direct sunlight.
10. Keep *ghee* containers tightly sealed.
11. Where possible, make *ghee* directly from cream.
12. Do not adulterate your *ghee*. It can be easily detected. You will be the loser in the long run.
13. Make the best possible *ghee*. Cooperate and demand a just price.
14. Science is at your service and make the best use of what knowledge is already available.

EVERLASTING BUTTER

A BUTTER that will keep indefinitely without refrigeration has been developed by the Australian Council for Scientific Research, working with the Queensland Dairy Board.

Research workers decided that butter goes bad because of microscopic cavities which hold water. The new process yields a butter fat almost devoid of moisture. The mixture contains a little casein and neutral nut oil, and a highly purified salt. It is made into 'normal butter of excellent quality' by adding one-fifth of its volume of water.

The Queensland dairy industry expects a considerable demand for the new butter for use aboard ships, and for export throughout the Far East.—*Agricultural Newsletter*, No. AGN/195.

INCREASING POTATO PRODUCTION

By PUSHKARNATH

PERHAPS at no period in the history of a country are problems of economic application, especially those connected with greater food production, more important than at the time of national emergency. India finds herself to-day in the state of national emergency when every ounce of food counts. Potato is the crop, which if given due attention, can contribute to bridge over this anxious period of food scarcity. This humble tuber has attained the foremost place in the dietary of the Western nations. 'France will thank you sometime hence because you have found bread for the poor'. These were the words of King Louis XVI for Parmentier who is credited to have discovered this new food crop in France. Germany has to thank the great famine of 1771-72 that brought potato in the fore-front in her domestic economy and to-day Germany without potatoes cannot exist. Potato competes with maize and other cereals as regards its nutritive value. Unfortunately in India potato has not yet received due recognition as an important food crop and has hitherto been regarded as a vegetable—a luxury chiefly for the town-dwellers.

High nutritive value

Potato has high nutritive value. Its carbohydrate content, reckoned on dry weight basis, is about the same as that of white bread. The protein content is lower but its quality is high. It's also a rich source of vitamin C and contains vitamin B_1.

TABLE I

Composition of potatoes and white bread

	Percentage of protein		Percentage of carbohydrate		Calories per 100 grams	
	dry	fresh	dry	fresh	dry	fresh
Peeled and boiled potatoes	6·6	1·3	98	19·7	435	87
White bread	10·6	7·2	79	54·0	382	260

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High yield and wide adaptability

Potato is potentially a heavy yielding crop plant. Even under present neglected conditions the potato crop yields, on an average, over 100 maunds to an acre and about three times more calories of food per acre than any cereal crop.

Potato is a crop which is adapted to a wide and often diverse range of climatic conditions. In India it is grown from near about the sea-level to a height of over 9,000 ft. up on the Himalayan slopes. It is grown in long summer days in the hills and short winter days in plains. In many tracts in the plains two crops of potatoes are raised within a short period of about six months and at some places, as in the Nilgiri Hills, where winter is not very severe, three different crops can be grown in a year. It is a crop which responds liberally to cultural and manurial treatments. The potentiality of this crop has not yet been fully exploited.

Our immediate needs

Our immediate needs are two-fold, namely to make the potato crop popular and to produce more. Our pre-war consumption *per capita*, per annum, was about 9 lb. compared to about 440 lb. of Germany. In India there is a great scope for making potato more popular. There is no serious prejudice, as was the case in earlier periods in the several Western countries, against this crop. Unlike the Wesern countries, where potato is familiar mostly in the form of baked and boiled potatoes or as chips, the Indian housewife knows to serve it in a variety of ways. Mashed potato if mixed with wheat flour gives excellent *chapatties.* If it could be had at a cheap price there seems to be no reason why people will not eat it in larger quantities and appreciate the value of this useful tuber as an article of food.

Increase in production and thereby cheapening the price is linked with several problems, both agricultural and otherwise. Here, however, only practical means of increasing the production of potatoes, within a reasonable time, need be mentioned. With the adoption of the suggestions made below and the existing area under potatoes remaining what it is at present, the yields can be greatly increased particularly in the hills.

Selection of right type of seed

Two of our important varieties in the hills are 'Up-to-date' in the northern hill tracts and 'Great Scot' in the southern hills. Both these varieties are potentially high yielders but, being riddled with virus diseases, our commercial seed-stocks have degenerated and at present are at a very low level of production. If large quantities of healthy seed-stocks of both these varieties are imported and multiplied under reasonably virus-free conditions and the existing commercial stocks replaced with these, there is no doubt that these will yield an immediate return. Certified healthy seed-stocks of 'Up-to-date' are available in Australia and of 'Great Scot' in the United Kingdom. Healthy nucleus stocks of both these varieties are now available at the Simla Potato Breeding Station. Besides these two varieties, some of the Simla hybrids, namely Nos. 2, 9 and 12 have proved superior to the existing varieties in the hills. Trials conducted with a large number of hybrids in the plains at the Indian Agricultural Research Institute, New Delhi and its sub-station at Pusa (Bihar) have resulted in some excellent hybrids which as early varieties give much higher yields than the existing *Gola* and *Numbri* types. What is needed is rapid and quick method of multiplication and immediate distribution.

Rapid multiplication of seed-stocks

Having secured the disease-free stocks of the right type of varieties their multiplication under normal circumstances means patient work for several years. India today is fortunate in having discovered by its own people rapid and efficient methods of multiplication of seed-stocks. It is no exaggeration to say that what could not have been so far achieved in 10 years can now be done in just one year. 'Sproutling' method of potato propagation offers a quick means of multiplying seed-stocks with the greatest rapidity. Very recent success achieved at the Simla Potato Station in using the terminal portions of young growing plants in place of seed-tubers further presents unlimited possibilities in increasing the seed-stocks. Both these methods are simple and efficient and with proper planning multiplication of disease-free seed-stocks should no longer remain a problem.

Multiplying seed-stock through sprouts

Hitherto, potato has been propagated through tubers. Each tuber possesses several eyes which produce the sprouts. These sprouts can be used as seed. The 'sproutling' method of potato-growing consists of forcing the tuber to sprout and each tuber under suitable conditions for sprouting can yield four to five successive crops of sprouts. From the experiments carried out at the Simla Potato Breeding Station a medium-sized tuber can on an average yield a total of 20 to 30 sprouts. Each detached sprout, about 1 to 2 in. in length, can be made to grow in a full plant yielding a normal crop of tubers. Longer sprouts can be cut into two or more parts, as the length permits, and from each piece of sprout a plant secured. This is, briefly stated, achieved by planting the detached sprouts or cut-pieces of sprouts closely in rich soil bed. The sprouts under suitable conditions for growth set roots within about a week's time and in another four weeks' time the sprouts grow appreciably and develop into 'sproutlings', i.e. young potato plants. The 'sproutlings' being very hardy, can be dug out, put in a basket and transplanted out in the field to be used in place of seed. Frequent waterings for about a week or ten days after transplanting is all that is necessary for the sproutlings to set roots. Once the sproutlings have established the crop does not need any special treatment[1].

The value of this method for rapid building up of our seed-stocks can be fully appreciated from the following figures.

A medium-sized tuber, on cutting, gives on an average four seed-pieces. Presuming all the four seed-pieces survive and each plant on maturity yields five tubers per plant, on an average, we can multiply from one tuber in the ratio given in Table II.

It will be observed from the Table that in the 5th year one could multiply over 3,000 times more tubers through sprouts than from the tubers alone. The value of this rapid multiplication of seed-stocks through sprouts cannot, thus, be under-estimated.

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[1] Pushkarnath, Sproutling Method of Potato Growing, *Indian Farming*, Vol. VI, No. 4.

TABLE II

Total number of tubers produced from one tuber

			Ratio of multiplication	
	From seed-pieces	From sprouts*	Seed pieces	Sprouts
1st year	20	100	1	5
2nd year	400	10,000	1	25
3rd year	8,000	1,000,000	1	125
4th year	160,000	100,000,000	1	625
5th year	3,200,000	10,000,000,000	1	3125

*Presuming each tuber will on an average give rise to 25 sprouts, i. e. 25 plants and each plant on maturity yields only four tubers.

But this is not the limit we have reached. Very recent work has shown that under conditions prevailing in the hills of India it is also possible to multiply the seed-stocks through pieces of young growing shoots.

Multiplying seed-stocks through 'top shoots'

From young plants the terminal growing shoots are cut about three inches in length. The shoots are planted closely in seedling beds consisting of rich loose soil similar to that used for germinating seeds. Protection from direct sun for about a week and frequent watering to keep the beds moist is all that is necessary for the potato shoots to strike roots. With a light application of sulphate of ammonia, after about ten days, the tops will be ready in another two weeks' time for transplanting in the field. Plants raised from the 'top-shoots' grow normally and yield good tubers. They set tubers much earlier than the normal crop. This is a great advantage. Experiments are still in progress to determine the yielding capacity of the crop raised by this 'top-shoot' method. It is unlikely that such crop will give as good a yield as secured from sprouts or tubers. But, the value of this method in building up seed-stocks is immense. Germany in her days of national calamity successfully utilized top-shoots in place of seed.

Multiplying the stocks in the hills

Degeneration of the potato stocks is now known to be the result of several virus diseases which infecting the tuber reduce its yielding capacity. Use of diseased stocks may lower the yields by well over 50 per cent. No authentic information about the losses in yield through the use of degenerated seed-stocks in this country is available. There can, however, be no doubt that the annual losses in yield are enormous, for our crops, being fully saturated with one or several of these diseases, are at a low level of productive power.

In the plains of India the seed-stocks degenerate very rapidly and it is not possible to maintain the health standards of a variety for any length of time. In the cooler regions, however, incidence of virus diseases being low, it is possible to keep the stocks in a healthy state. Building up of seed-stocks must, therefore, proceed in the higher hills. There is yet another advantage to start multiplication project in the hills. It is much more easy to multiply the seed-stocks through sprouts and 'top-shoots' in the hills than in the plains.

Bringing down of seed-stocks from hills to some parts in the plains may appear to be a difficult proposition. A careful planning can overcome this difficulty and even to-day a very considerable part of our seed-stocks grown in the plains originates from the hills.

A practical plan

In India the Simla Hills in the Punjab and Kumaon and Dehra Dun Hills in the United Provinces are important centres of seed-potatoes not only for the hills but for the plains as well. How important these hill tracts are, may be visualized from the figures of export of seed-potatoes from Simla maintained by the Regional Food Commissioner.

Clustered round Simla are a number of Hill States where the chief money crop of the cultivator is potato. The produce of these scattered, terraced hill slopes annually pours into Simla where it is stored, sorted, packed and despatched to various provinces. Table III gives the requirements of various Provinces/States of India for potatoes from Simla Hills.

The figures given in the Table will show that Simla exports about five and a half lakhs of maunds annually. These figures, however, do not include stocks exported to Pakistan territory, especially Sind and Bahawalpur States, nor do they take into account local requirements and stocks retained by the cultivators for seed next season. Thus, well over 6 lakh maunds, valued at about a crore of rupees, is annually exported. Out of this nearly 4½ lakh maunds of potatoes are directly utilized for seed purposes.

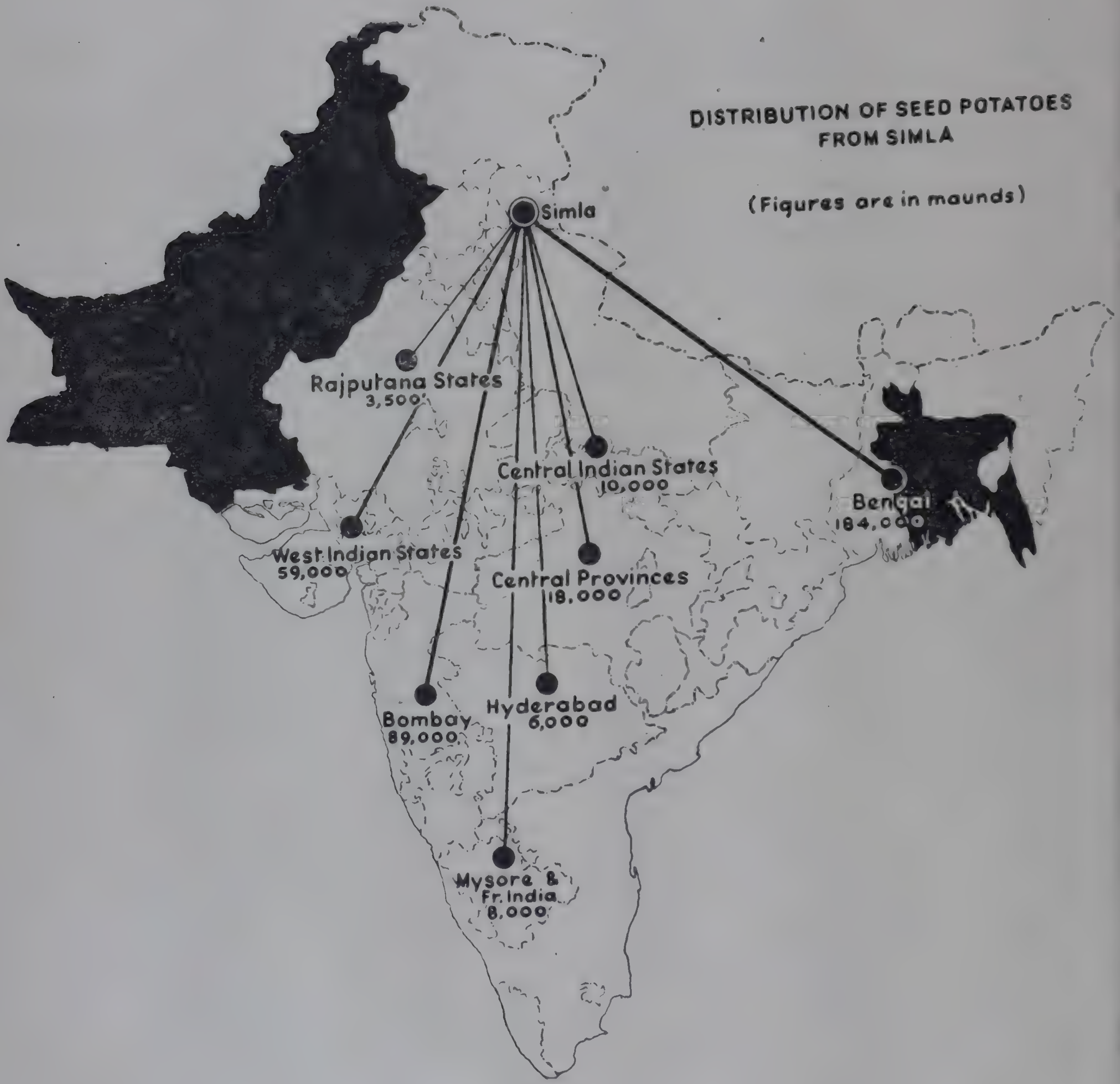
DISTRIBUTION OF SEED POTATOES FROM SIMLA
(Figures are in maunds)
Simla
Rajputana States 3,500
Central Indian States 10,000
Bengal 184,000
West Indian States 59,000
Central Provinces 18,000
Bombay 89,000
Hyderabad 6,000
Mysore & Fr. India 8,000

TABLE III

Approximate requirements of provinces/States for potatoes

Province	Table use	Seed stocks	Total
1. Delhi	22,500	Nil	22,500
2. United Provinces ..	49,000	Nil	49,000
3. Bihar ..	34,000	Nil	34,000
4. Central Provinces ..	8,500	18,000	26,500
5. Bombay ..	11,500	89,000	100,500
6. Rajputana States ..	4,000	3,500	7,500
7. States of Western India	Nil	59,000	59,000
8. Central India States ..	Nil	10,000	10,000
9. Hyderabad	Nil	6,000	6,000
10. Mysore and French India	Nil	8,000	8,000
11. Bengal ..	36,000	184,000	220,000
Total ...	165,500	377,500	543,000

Simla is an important seed-potato tract from an all-India point of view. Simla seed-potatoes find their way far and wide throughout India. There is an organized trade and reasonably well-worked out system of distribution. Simla possesses all the virtues necessary for seed-potato production. Multiplication of healthy seed-stock should, therefore, start at Simla and Kumaon or Dehra Dun Hills and later extended to other tracts. A small scheme could also be initiated in the Nilgiri Hills which though having only a local interest uses a type of potato very different from the North Indian types. If through careful planning we could only succeed in replacing the existing degenerated types, the result will be beneficial and far-reaching.

Once the seed-stocks of better types have been built up and made available to the public there are great possibilities for private enterprise. Establishment on scientific lines of agencies or seed-potato growers' associations will not only help in building up and distribution of healthy seed-stocks but also act as recognized concerns for assemblage and distribution of seed-potatoes. It is a new and a profitable industry full of promise and far-reaching possibilities.

Conclusion

By virtue of its high yield, its high nutritive value, wide genetic variability, adaptability to wide and varied range of climatic conditions and rapid response to cultural and manurial treatments, there can be no doubt about the value of potato as a food crop for our present starving millions.

FOR a crop of radish the field has to be ploughed sixty times, for a crop of cotton thirty times and for a crop of paddy fifteen times and then alone fortune is assured to the cultivator.—*Agricultural aphorism from Orissa.*

SUBSTITUTE POULTRY FEEDS

By D. PARTHASARATHY

DURING the past few years, there has been an increased demand for protective foods like eggs and meat mainly due to the conditions created by the war. The people are becoming more nutrition-minded and there is a growing appreciation of the importance of eggs and meat in the dietary of the people. But the raw materials from which these protective foods could be manufactured, e.g. cereals, their by-products, etc. have also been in short supply, thereby complicating the problem. The prices of grains and other related products have soared up very high, some of them being not available at all for feeding poultry. From a knowledge of poultry nutrition, suitable substitute feedstuffs should be computed from materials which are relatively abundant, cost less and are nearly as nutritive as their original counterparts. The wisdom of feeding costly feeds, like grain, their by-products and other concentrates to the poultry has been questioned. But the hen is one of the most effective of food processors. The feed it takes, after a process of selection and concentration, comes out neatly packaged with protein of high biological value and a good percentage of protective minerals and vitamins.

Poultry ration

During normal times the poultry ration consists of mash or grain or both and supplements of protein, vitamins and minerals. The mash consists of maize-meal, wheat-bran, rice-bran, ground oats, ground barley, etc. The grain ration consists of combinations of some of the following: *Cheena*, *bajra*, cracked yellow maize, yellow maize, paddy, wheat, oats, barley, *jowar*, etc.; the supplements consist of meat-meal, fish-meal, skimmed milk, bone-meal, limestone, salt, greens, etc.

Feeding substitutes

In the feeding of substitute feeds, the first step is to change from intensive or semi-intensive systems to free range system, so that lack of any essential nutrients in the feed is offset by grassland, and the insects, worms and other live objects available on it. The second step is to divert as far as possible all portions of home-grown feeds which are not meant for human consumption and other waste products, viz. cabbage leaves, cauliflower leaves, carrot tops, and kitchen wastes, etc. In effecting such substitution only growing and laying rations should be altered, leaving the chick rations to conform as far as possible to the normal standard, for the growers and layers have greater powers of adaptability to the changed feeds without much detriment. Besides the quantity of food consumed by the chickens up to eight weeks of age is not much to warrant economy by substitution. The first few weeks of a chick's life constitute a critical period so far as the metabolism of protein and certain vitamins specially vitamin-A are concerned; and a well-balanced ration during this period will secure a better growth than otherwise.

Substitutions in the ration

The following are some of the more important substitutes in poultry-feeding as determined by experiments conducted to-date both in India and abroad. Crushed oats may be available and can form up to 20 per cent of the feed. It is very beneficial and is a good source of iron. If not available, ground barley may replace ground oats weight for weight. Once the birds get accustomed to it, properly ground barley is as much relished by them as any other grain. Barley-meal can be used in fattening mashes. Yellow maize is an important item in poultry feeding noted for its easy digestibility and is a carbohydrate food. It also has vitamin-A activity due to its cryptoxanthin content. Some of the possible substitutes for yellow maize-meal are ground oats, ground barley, ground millets or mixtures of these. As these have little vitamin-A activity, it is advisable to supplement them with alfalfa

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or lucerne-meal. In localities where the cost is no deterrent boiled potatoes can successfully replace yellow maize-meal up to 25 per cent in the ration, for on a dry matter basis the percentage composition of potatoes is nearly the same as that of yellow maize. It has also been shown that the feeding value is greatly enhanced by boiling the potatoes as the digestibility of starch and protein has been found to increase with boiling. It is contended by some that production might be affected if potatoes exceed 40 per cent of the mash. Sweet potato-meal can be used up to 20 to 25 per cent of mash mixture and can replace carbohydrate feeds in the ration. Wheat and its by-products which possess a high feeding value for poultry cannot be spared in these days of food shortage as a poultry-feed. Experiments conducted at the Indian Veterinary Research Institute, Izatnagar, and elsewhere have revealed that *bajra* has a feeding value akin to wheat and the small size of the grain renders it suitable as a chick grain also. In Cambridge, it has been found that sunflower seeds also have an equal, if not more, feeding value as wheat. Wheat bran or rice bran forms an important constituent of the mash and lack of these gives rise to many a disorder. Wheat bran is a good source of some vitamins, viz. vitamin B, pantothenic acid, the growth-promoting factor. It is also a good source of some minerals, specially manganese. It is really a difficult problem to find out suitable substitutes for wheat bran without adversely affecting the nutritive value of the ration. Ground wheat, cocoanut-meal up to 25 per cent, and palm-kernel-meal are among the substitutes suggested, if available.

Other substitutes

Other grain substitutes to replace the more important cereals are *jowar*, *cheena* and ragi. Experiments conducted at the Indian Veterinary Research Institute, Izatnagar, indicate that *jowar* and *cheena*, particularly the latter, do not rank high in their nutritive value, although as a chick grain *cheena* is very well-relished. Ragi, a popular grain in South India, has been found to be very beneficial in poultry-feeding because of its high palatability and small size. These grains, when ground, can be incorporated in the mash also. In compounding a poultry ration it is a wise practice to have a mixture of several grains to insure against a deficiency of the so-called amino-acids.

Supplements

As regards the supplements, protein is the most important and expensive. Animal protein is considered superior to vegetable protein and experience has shown that 20 to 40 per cent of the protein must come from animal sources if beneficial results are to be attained; but it is very difficult to obtain animal protein these days. Meat offals (intestines from the slaughter-house) can replace the rather costly meat-meal or fish-meal. Separated milk is an ideal protein supplement but for its cost. Butter-milk or whey or even meat offals have been found to approximate milk in feeding value. In general, the beneficial value of animal protein supplements is due to the completeness of their amino-acids, the so-called 'bricks', out of which the proteins are built up, while the vegetable proteins often lack some of these. Incidentally, animal products serve as good sources of minerals and vitamins as well. Nevertheless, good growth and good egg-production can still be obtained on diets, a large portion of which comes from vegetable sources, provided the ration is balanced in respect of vitamins and minerals whose importance cannot be underestimated.

Among the vegetable protein supplements, the important ones are, soyabean-meal, groundnut-meal, sesame-meal (*thill*), and peanut-meal. Soyabean-meal has been found to be an excellent protein supplement. Its efficiency can be considerably improved by proper processing. A combination of soyabean-meal with a minimum of animal protein such as milk makes an ideal protein supplement. It is claimed by some workers that nearly as good growth can be obtained with soyabean-meal supplement as with separated milk as a protein supplement. Groundnut-meal *plus* salt can be an effective substitute for milk or meat offals as regards rate of growth, general health, rapidity of sexual maturity and efficiency of food utilization. Soyabean-meal and groundnut-meal have been found to be almost of equal value as protein supplements in the rations of chicks, although for egg-production they have not been found to be quite as good. Sesame-meal has been found to contain all the essential amino-acids for the chick but one, and hence can be used with other feeds, when the deficiency is likely to be compensated. Peas and peanut-meal are valuable supplements to fall back on in times of emergency. Experiments have indicated that at least 50 per cent of the more expensive animal protein concentrates can be replaced with peanut-meal. The supplementary value of pea-meal to the protein of a cereal basal diet consisting of wheat, maize, wheat bran, and oats has been found to be half of the value of casein. Undergrade groundnuts can successfully replace up to 28 per cent of the ration of growing chickens and 3·5 lb. of groundnuts can replace 1 lb. of fish-meal. It is advisable to add to these a small amount of skimmed milk. Cottonseed-meal may be used with advantage in laying mashes for egg-production but the only drawback is that the eggs after storage develop a dark colour in the yolk rendering them unfit for sale. The use of cowpeas in poultry-feeding gave encouraging results. Cowpea hay can replace lucerne-meal, the green plant serving as a green food also. In growing and laying rations cowpea-meal at 15 per cent level can be used as a partial substitute for meat or fish-meal. Baking of cowpeas considerably increases their nutritive value. It is advisable to supplement these vegetable proteins with a proper mineral mixture.

Green feeds

Green feeds serve not only as vitamin supplements but also effect a considerable saving in the consumption of mash. Mustard leaves can be the mainstay if other green feeds like berseem and lucerne are not procurable. Cabbage leaves, cauliflower leaves, carrot tops, radish tops and spinach serve as good green feeds. Silage used for cattle can also be given to poultry with advantage, although it is a moot point how far it would effect any saving in the mash. However, during periods of acute shortage this can be a good stand-by. The value of good poultry pastures is considerable. They not only effect a saving of about 5 to 10 per cent of the total feed consumption but in their presence, only smaller amounts of the critical ingredients like milk products, alfalfa and animal protein concentrates need be used. On good pasture favourable results have been obtained with growers and layers by feeding a ration of cereals, minerals and vegetable protein concentrates.

Waste products

Among the miscellaneous class of feeds, on which much work has not been done but which promise to be good substitutes, are kitchen wastes which can be fed up to half of the daily consumption and *chuni* (the outer husk of some pulses), a concentrated form of some vitamins and minerals.

Though the substitutes mentioned above are numerous, it may be emphasized that no single ration comprising these substitutes can be recommended as applicable for the whole of India. The extent to which these substitutes will be of permanent value to the poultry-keeper largely depends on their price and availability.

Gros Michel: A new banana for India.

A NEW BANANA FOR INDIA

By K. CHERIAN JACOB

GROS Michel is the variety of banana which is extensively grown in the West Indies and shipped to Europe and America in large quantities in specially fitted and air-conditioned steamers. The home of this banana is said to be somewhere in the Far East, viz. Siam, Java or Malaya. It is known in Malaya as *Pisang emben*, Siam as *Klui hom*, Burma as *Thihmwe* and Ceylon as *Anamalu*. Strange enough, it is not found in South India which is the home of many varieties of banana. Two strains of this variety, one from Honolulu (Hawaii) under the name Blue Field, and the other from Trinidad (West Indies) under the name Gros Michel, were obtained and tried in the banana plot attached to the Agricultural Research Institute, Coimbatore. Both proved to be same when grown at Coimbatore. The bunches are large with 7 to 9 hands and each hand with 16 to 20 fruits, each 7 in. long. The bunch is very compact and the fruits are fairly strongly attached to the pedicel. The pulp is very sweet with excellent flavour and at flecked stage it actually 'melts' in the mouth. It is an excellent dessert banana. It thrives well under all conditions of soil and climate up to an elevation of 4,500 ft. It is a good banana both for export and home use.

Breeding out superior clones in banana has not yet been a great success. Bud sports of superior clones are quite a common occurrence in this crop. The easiest method of improvement of banana, therefore, is by the trial of all the best known banana varieties in a suitable place and distributing them after acclimatization and multiplication. Gros Michel is an ideal variety for trial. A few suckers may be available for distribution with the Superintendent, Central Farm, Coimbatore.

What the Scientists are doing

EFFECT OF *JOWAR* AND MAIZE ON SUCCEEDING CROPS

FROM experiments conducted at Indian Agricultural Research Institute, New Delhi, to ascertain the extent to which the crop yields are effected after maize has been grown, it was found that the yields of wheat were reduced by 16·87 per cent in 1938-39 and by 37 per cent in 1939-40, when compared with the yields after fallow. From Table I, showing the average yield data of five years (1930-31 to 1934-35), it is clear that in the first experiment an increase of 18·6 per cent in the yield of wheat after maize and *urad* mixed crop was obtained as compared to that of wheat after maize. Further from the second experiment cited in the same Table showing the average yield of five years (1930-31 to 1934-35), it can be seen that there was an increase of 14·4 per cent in the yield of maize after barley and *kerao* (legume) mixed crop as compared to that of maize after barley. The differences in yields are negligible for some years.

TABLE I

Pusa experiments on the yield of wheat and maize

1st Experiment

Year	Yield of wheat after maize Maunds	Yield of wheat after maize and *urad* mixed Maunds
1931	9·6	10·6
1932	6·5	9·3
1933	11·5	11·8
1934	11·5	14·1
1935	6·5	8·1
Average ..	9·1	10·8

Increase over wheat after maize 18·6 per cent

2nd Experiment

Year	Yield of maize after barley Maunds	Yield of maize after barley and *kerao* mixed Maunds
1930–31 ..	9·8	9·9
1931–32 ..	6·3	7·0
1932–33 ..	16·4	20·7
1933–34 ..	9·2	9·4
1934–35 ..	10·5	12·5
Average ..	10·4	11·9

Increase over maize after barley 14·4 per cent

When the interval between the two operations was increased from the normal period of 36 days to 51 days, the yield was increased by 51 per cent and when the interval was 78 days, the increase in yield was 52·8 per cent. The following data of Burt* show similar effect of increase in interval in the United Provinces on the yield of wheat that followed *jowar* (Table II).

TABLE II

Effect of increase in interval of yield of wheat after jowar

		Yield of wheat
Jowar removed and land ploughed on	28 August (63 days)	20·8 maunds
,,	8 Sept. (52 days)	13·5 ,,
,,	16 Sept. (44 days)	11·7 ,,

Wheat was sown on 30 October

From experiments at Nagpur it was seen that the yield of wheat after *jowar* fodder was lower than that of wheat after fallow.

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*Burt B. C., *Agril. J. India.* **12**, 538-539.

Further the yield of wheat after *jowar* and *tur* (legume) mixed crop was greater than that of wheat after wheat in the years 1890-91 to 1894-95.

The experiments in Madras Presidency showed that the yield of cotton after *jowar* is less than that of cotton after *bajra*, while there was no appreciable difference between the yield of chillies, tobacco or *jowar* after *jowar* and the yields of the same crop after *bajra*.

Results from Kanpur indicated that the yield of wheat after *jowar* fodder was lower than that of wheat after fallow.

The harmful effects of these two crops on the succeeding crops appear to be due to the following reasons :

(1) Toxin or toxins secreted by the roots of the crops, which seem very unstable because they have so far defied chemical isolation, might directly injure the roots of the succeeding crops.

(2) The toxin might also check bacterial action, reduce carbon-dioxide production and defloculate the soil by altering the equilibrium between sodium and calcium.

(3) There is experimental evidence to indicate the possibility of a detrimental effect of maize secretion on nitrifying organisms. It appears that nitrogen starvation is caused at an early stage of the growth of wheat succeeding maize ; this is ultimately reflected on the final yield of wheat. The harmful effects can, however, be overcome by aeration or use of calcium carbonate, ferric hydrate or manganese-dioxide.

(4) The growing of *jowar* disturbed the sodium content of a soil. The soil was left more alkaline at the time of sowing cotton than the soil in which *bajra* was grown as a previous crop in Madras Presidency.

(5) Experiments at Padegaon showed that cotton and *jowar* build up water-stable structure during their growth period which persisted even after the harvest of these crops.

Considering the above evidence it appears that the after-effect of maize or *jowar* is interference in some way or other with process of enrichment of total and available nitrogen in the soil and can at least be partially overcome among other method by

(i) including a legume in the rotation,

(ii) increasing the interval between the two cereals *maize* or *jowar*, and *wheat* or *barley*, and

(iii) applying heavy doses of a mixture of organic and inorganic nitrogenous manures.

The one important point is that the problem arises as a result of bad farming systems and it may cease to be when methods of cropping and crop management, which restore soil fertility of stable type, are introduced. (I.A.R.I.).

You ask We answer

Enquiries regarding agriculture and animal husbandry shoud be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Is Brucellosis a serious disease in India? What economic losses are caused by it and how can it be eradicated?

A. Brucellosis, commonly referred to as contagious abortion or Bang's disease is responsible for causing heavy losses to the livestock industry of this country. The disease occurs in India in form of epidemics, endemics and flare-ups of endemics. Zebu and buffaloes are comparatively less susceptible than the imported pure-breds or European-zebu crosses. Its annual incidence in this country is commonly from 1 to 5 per cent of the breeding stock, though not infrequently 5 to 15 per cent incidence is recorded. More commonly the disease occurs in the humid tracts of the south-east where the infection appears to be indigenous, while in the desert tracts of the north-west the disease is comparatively rare. In organized farms imported infection is present irrespective of its situation.

This disease causes significant economic losses, as we lose in way of calf that is born dead or is weak and soon dies, the diminished production of milk in dairy animals, the temporary or permanent sterility that may follow the infection and not infrequently the loss of the cow itself through infection. The breeder may also suffer financial losses due to interference in the breeding programme when the disease is present in the herd. Among the working bullocks this disease is the major cause of synovitis and results in tremendous loss of working capacity in the affected animals.

In desert areas factors responsible for the limitation of the spread of Brucellosis are abundant sunshine, dryness, dispersion of cattle and simple hygiene. Reverse conditions such as lack of sunshine, humidity, congestion and lack of hygiene increase the incidence of the disease in humid areas.

There is no drug, chemical or medicinal compound, that has proved effective in prevention or cure of brucellosis. In dry and desert areas the disease can be easily controlled by educating the cattle-owners to practise open-air hygienic farming. But in humid areas, vaccination of the animals with a single dose of 5 c.c. of the Brucella vaccine can be done with very encouraging results. The subjects for vaccination are empty females, virgin heifers shortly before service is anticipated or 4 to 8 months old calves. Heifer vaccination is preferred. The vaccine can be obtained from the Indian Veterinary Research Institute, Mukteswar. If possible, vaccination should be performed during winter season when under proper conditions of cold storage the vaccine keeps potent from three weeks to two months. High temperature or agitation causes deterioration of the vaccine. During summer the period of validity of vaccine should not exceed from 7 to 10 days from date of despatch.

Another practical and economical method of control is proper sanitary herd management. The reactors should be segregated and non-reactors should be tested after frequent intervals. Every care should be taken to prevent infection gaining entrance into a normal herd. All the new animals added to a herd should be negative to agglutination test used for diagnosing this disease. Animals purchased from cattle fairs and other markets should always be tested before admission to the herd. (H.K.L.)

INDIAN FORESTS AND INDUSTRIAL DEVELOPMENT*

AMONG primitive peoples wood and other forest products serve a wide range of domestic needs and are indispensable to their methods of life. The industrial and commercial nations of the world have developed numberless substitutes for wood but have not thereby decreased their consumption of it or become less dependent on forests. New demands have arisen that utilize the products of forests in a multitude of ways unknown to primitive man. Directly or indirectly every aspect of modern life would be handicapped if the woods, resins and other products of forests become scarce or unduly expensive. Some of the numerous ways in which these products help, are in the growing and packing of foods, the manufacture of plastics, clothing and paper, the construction of means of transport and communications and the making of a wide range of items of less essential nature.

An age-old engineering material

Think of the use of wood for structural purposes in all its myriad forms. It has carried loads, transported foods, framed and sheathed buildings and sheltered the builder. The use of wood as railway sleepers, while relatively small in volume, is of tremendous importance. It is hard to conceive of the railway transportation system having reached into all the corners of the globe except upon a wood base. This age-old engineering material, wood, has delivered unusually valuable service to man.

In India, the regions of the Himalayas and other mountain tracts well-supplied with rainfall, originally supported vast forests of a quality as good as in any other continent. This heritage has been freely used; much of it has been wasted, but fortunately a good part of it still remains. About one-sixth of India's land area is still covered with forests. An intelligent consideration of the wise use, conservation and protection of these essential materials is the duty of every Indian. This has been forcefully brought to our notice twice during recent weeks. The Agriculture Secretary of the Indian Government speaking at the meeting of the Central Board on Forest Utilization at Dehra Dun, said:

> 'India's forest policy in the past appears to have been static in character; now it must be more dynamic. The use of our forest resources for the industrial development of our country must be given a prominent place in our future programme of forest development'.

Later Shri Jairamdas Doulatram, the Agriculture Minister of the Government of India in his convocation address at the Indian Forest College stressed the same point:

> 'We must make our forests the hand-maid of agriculture and industry. They must protect our agriculture against the consequences of floods and other elemental forces of nature. Our forests must subserve and feed our industries with the raw materials that they need. The day should soon come when every square mile of Indian forests is exploited to its fullest extent in the service of agriculture and industry'.

Against this background, it would be useful to briefly survey the work done at the Indian Forest Research Institute, Dehra Dun, and look for a few useful lines of development for the future.

Silviculture

It is the object of forest management to give to man full possession and control of the forest. Forest management in its broad sense is a long and exacting process which involves the investment of considerable capital. A forest is more than a mere group of trees. It includes not only the trees but also the soil, the undergrowth and reproduction as also game, livestock, insects and men that resort to it. The component parts of a forest bear the same relation to each other as do the individuals in a village or town. The trees are mutually dependent against wind-throw, and snow-break and the close canopy of the trees allows the formation of that essential complex compound 'humus', which is used for maintaining soil fertility. At the same time the trees compete for food, moisture and light. So intensive is the struggle for existence in forest life that 100 trees on an acre at maturity, may be the final survivals of 10,000 seedlings that started life.

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*A Review of Research Schemes at Forest Research Institute, Dehra Dun.

A forest is the product of soil and climate. Silviculture is the science of biological response to environment utilized for growing trees and forest crops, and affording them protection till maturity.

The work of the silviculturist is therefore of great value not only to the forest departments of Indian provinces and States, but also to the owners of private forests, industries using wood, and land-owners or corporations engaged in tree planting.

Closely linked with silviculture are two subjects of universal interest—land use and erosion. India is already alive to the dangers of the latter. Valuable information has been collated and published on some aspects of erosion control, including effects of control of grazing, stocking with better grasses and contour trenching.

Fuel

The largest use of wood, fuel, is the most primitive, the most wasteful and among the most important. Considerable work has been done on collecting information about suitable species, and some material has been published on the silviculture of village and fuel plantation.

Death-dealing insects

An epidemic, which a little over 30 years ago destroyed 60 lakhs of trees in Central and North India and caused the nation a loss running into several crores of rupees, was due to an insect, the sal borer; the spike disease of sandal in Coorg, Madras, and Mysore is estimated to have killed sandal trees valued at over Rs. 2 crores. These figures give a measure of the destructive power of insects on forest trees and forest products.

The entomologist aims to check or prevent such losses. It is for him to ascertain what groups of insects are most injurious to particular trees or timber, to study their life-history and rate of development, and determine suitable and practical methods of preventing their increase. The control schemes devised for the sal heartwood boring insect, have enabled the forest departments of the States and the provinces, to adopt standard measures at insignificant costs. It is now possible to predict with confidence the periods of epidemics and the precautionary measures to be taken.

The entomologist has also proved that the high rate of mortality among sandal trees is due to a disease caused by a virus which is carried by a sap-sucking insect. New outbreaks have been suppressed and the spread of the disease checked.

To a casual observer the entomologist has no connection with forest products and their utilization in industry. It is not however generally known, that industries concerned with the manufacture of furniture, packing cases, plywood, matches and sports goods have to guard against special insect pests. A few examples will illustrate the importance of the subject. (1) As a result of measures taken, the plywood industry in Assam to-day produces tea chests and panels that leave the factories entirely free from the defects due to a certain type of beetles. (2) Advice on mill hygiene given to the manufacturers of packing cases and matches in Bengal, the Central Provinces and Bombay has eliminated complaints of defective finish. (3) Rejections of pith hats by the Army because of the damage by an insect have ceased as a result of suitable remedies taken. (4) Complaints from the Army regarding solid bamboos used as lances and from the police about their lathis have ceased, because of suitable preventives against damage by an insect which feeds on the sap of bamboos. (5) Frequent and serious interruptions on the high voltage transmission cables caused by swarms of flies in the United Provinces have been successfully prevented.

The entomologist lists more than 100 species of white ants and the prevention of damage by them is a widespread problem. The species vary widely in their habits and before effective control measures can be confidently prescribed, thorough biological studies are needed. Exploratory work in this connection has been carried out at the Research Institute during the last three years. This must now be followed up with a comprehensive survey of these destructive insects, their biology and control measures.

2½ lakh plant specimens

The herbarium of the Indian Forest Research Institute comprises over 2½ lakh plant specimens representing the flora of all parts of the world, but more specially of India. It forms the basis of all fundamental research in systematic botany, in describing plants new to science and in bringing to light the little known plants from the myriad types growing in the forests. When dealing with plant produce, whether timber or other, it is of the greatest importance to correlate with the several items of research, the correct identity of the species concerned.

To take only one example : the importance of grasses is well-recognized, not only as raw material for making paper and essential oils but also as indicators of soil and forest types.

Utilization of forest products

The variety and abundance of Indian economic forest products (technically called 'minor forest products') is perhaps unequalled in any other similar area in the world. Over 3,000 species of plants besides a large number of animal products play an important role in the rural and industrial economy of the nation. Essential oils, resins and gums, fatty oils and fats, medicinal plants, canes, bamboos, grasses, other products such as honey and lac, and materials for packing and wrapping are the means of livelihood for millions of inhabitants near the forest. Many of these 'minor products' valued at crores of rupees form the raw material for a number of modern industries, and some are also valuable items of international trade.

In 1939-40 raw materials worth about Rs. 4 crores were exported. In addition there are many other items, which if properly investigated and utilized, will improve the economic position of the country. To cite one example: till about five years ago 35 lakhs of maunds of tamarind seed were thrown away as waste; to-day nearly six lakh maunds of seed kernels are being turned into a product similar to starch for sizing purposes. Investigations also show that tamarind seed kernels are by far the cheapest source of a 'pectin', which is utilized in the preparation of jams and jellies. And so the quest for substitutes proceeds apace at a tempo quickened by the necessities of a free nation awaiting great industrial development. It is a quest which may produce results even more astonishing than those already achieved, not only in reference to the materials and substitutes available in India's forests, but also in reference to the revolution that may be effected in the economics of our country. The ready availability of a wealth of raw materials in India might well act as an incentive to the successful development of many new industries.

Two other examples will illustrate the vast potentialities for the exploitation of forest products other than timber.

Camphor

The most important natural source of camphor, supplying 75 per cent of the world's demand, is a plant which has failed as a commercial proposition in India. The manufacture of synthetic camphor has also proved uneconomical. Experiments conducted on the cultivation of a little known shrubby plant in India, show that it yields camphor which is identical in all respects to the imported commodity. This plant can be harvested within six months of its sowing. India's annual imports of camphor average 20,00,000 lb.; with the rapid industrialization of the country, the demand for camphor will increase rapidly.

Soil stabilization

Four years ago experiments conducted at the Forest Research Institute revealed the property of certain forest products in bringing about the stabilization of soil and their binding property for sand. Think of the lasting benefits of this research to the millions of India's village population, whose mud houses are every year washed away and where village roads become impassable during the monsoon. If further experiments on this *pakki matti* are successful, the teeming poor of India will have, at an insignificant cost, mud houses that will stand up against heavy rains, floors that will match cement ones, and roads that will be impervious to the ravages of the rains.

Wood for aircraft and ship-building

India produces about 4,000 different timbers, not all of which can be exploited economically. The development of forest industries therefore depends in a large measure upon the science of wood technology which deals with the internal structure of different timbers and recommends their most suitable uses. Two examples will illustrate how wood technology facilitates the scientific and efficient management of industries. The spruce of North America is the most important timber in the world for aircraft construction. During the last two wars this timber was practically unavailable in India. Field surveys which were started in the hill forests of the Punjab and the United Provinces showed that aircraft quality timber is available in this country in the Indian varieties of spruce and fir.

A special type of South American timber used for certain parts of ships was lost to India during the last war and the prices rocketted to Rs. 500 per c. ft. against a normal of Rs. 15. Surveys made in Bombay and Madras revealed a suitable substitute known as the 'red cutch' which is now available at Rs. 10 to 15 per c. ft. and is being used by most of the ship-building firms in Bombay.

Teak, an increasingly expensive raw material, has for centuries been used for ship-building. There is no reason why attempts should not be made to find substitutes for teak at least for the non-vital parts of the ships.

Wood seasoning

Wood seasoning is intimately connected with the development of wood-working industries and the utilization of wood in any form for wooden poles, railway sleepers and carriages, for furniture and cabinet making, packing case manufacture, shuttles, bobbins, sports goods and bent wood articles, plywood and laminated wood, for rifle furniture and the various ordnance stores. In the past Indian timbers have suffered against imported varieties because of a lack of proper seasoning of the wood before use.

A great deal of work was carried out on this subject during the war, when supplies of foreign timber were suddenly lost to India. Among the important investigations made are: the suitability of Indian timbers for textile and jute mill accessories such as bobbins, shuttles and for pencils. At present the latter industry depends largely upon imported timber.

For the manufacture of handles of umbrellas and walking sticks, sports goods and bentwood furniture, it is necessary to investigate the bending properties of Indian woods. Some work in this connection has already been done but considerable progress has still to be made. The importance of this investigation has increased considerably on account of the partition of the country; sports goods manufacture has for long been concentrated at Sialkot, which is now in Pakistan.

Wood to relieve steel shortage

Till recently wood has been used mostly in the natural state with all its attendant defects. Recent researches have been directed towards improving the properties of wood so that it can withstand the competition from other powerful competitors. The subject has, as a result of the war, assumed enormous importance because of an overall shortage of steel. As against India's minimum annual requirements of two million tons of steel the availabilities are reported to be only about a million tons. Either the country's industrial development and its building programme are to be hampered and delayed or 'treated' wood has to replace steel in many directions. The work on this subject is, therefore, of immediate importance to the railways, the ship-building and aircraft industries, the telephone, telegraph and electricity industry, the chemical, plywood, adhesives, sports goods, textile and all other industries utilizing wood. In this endeavour is involved Rs. 15 crores worth of timber per annum.

Railway sleepers

The foundations of wood preservation research in India were laid about 30 years ago; the first commercial wood-treating plant which was started at Dhilwan in the Punjab has treated over 4 million railway sleepers. There are at present six creosoting and some ascu plants in operation in India, which impregnate several lakhs of cubic feet of timber annually against decay and termites' attack.

The total demand for railway sleepers during the next few years is estimated at 39 lakhs of broad gauge and 25 lakhs of metre gauge sleepers costing about Rs. 5 crores per annum. With the decrease in the available supplies of naturally durable sleepers, the more extensive use of treated sleepers has become imperative and the Government of India are reported to be working on a scheme of opening many more centres for the treatment of Indian wood.

Another important field of timber utilization in which wood preservation plays an important part is that of marine structures. Several lakhs of cubic feet of timber are used in Indian harbours and trials are in progress to test the efficiency and economy of different types of preservative treatment.

Adhesives

Casein, which is imported from abroad, is an adhesive used in plywood manufacture. During the war its price rose from about Rs. 300 to Rs. 4,000 and to-day it is Rs. 6,000 per ton. Other sources of protein from indigenous materials for adhesives have been explored with encouraging results. They have been developed from groundnut, other seed cakes, and from a waste of starch ; the latest is the development of a weather-resistant adhesive from cashewnut shell oil, which is available in India.

Laminated wood

Growth defects in timber, like knots are localized and often form the weakest part of a wooden structure when solid wood is used. Such failures can be reduced by dividing wood into thin sheets or ' lamellae ' which are again glued together so that the localized defects are distributed. By using higher pressure during lamination, compregnated wood is produced. Laminated and compregnated wood can be used for aeroplane propellers, bearings, textile mill auxiliaries, electrical insulators and sports goods.

One hundred and fifty million square feet costing Rs. 4 crores is the estimated plywood demand in India. Although this industry developed greatly during the war, it is still in its infancy, requiring constant research and guidance. The suitability of various Indian species of timber for the manufacture of plywood has been investigated, and with the installation of a new composite wood plant, it should be possible to devise methods of utilizing species of Indian timber hitherto found unsuitable.

Cellulose

Wood, bamboos and grasses are important sources of celluclose, one of the basic requirements of a large group of chemical products now coming into prominence. They include rayon, cellulose and allied plastics, and nitrocellulose, the principal ingredient of certain explosives.

In modern civilization, paper, boards and celluose products play an important role. The development of the arts, science, agriculture, industry and commerce, the governance of countries, in fact almost every phase of human activity directed towards cultural progress, requires the use of paper pulp (cellulose) and boards. A number of the necessities and amenities of modern life is supplied directly or indirectly through cellulose as the basic material, e.g. artificial silk and staple, fibre, paper, textiles, plastic materials, photographic films and foils, explosives, lacquers and varnish, power alcohol and constructional boards.

We are all familiar with the excellence of rayon, which has enabled women of moderate incomes to dress almost as smartly as their more affluent sisters. But there was never any reason why the story should stop there, and it has not. It has added in the last few years chapter to chapter to the great story of the exploitation of the forests, to suit the increasing demands of modern civilization.

Paper

Paper is a felted sheet of plant fibres. Limited quantities of hand-made paper are still made from grasses, flax, straw and other vegetable fibres. Much high-grade paper is still made from rags and other relatively expensive materials. Cheap and abundant newsprint and wrapping papers are, however, the result of processes, that turn logs of wood into endless strips of paper, in the form of rolls having any desired width and weight.

The present potential productive capacity of 15 paper mills in India is estimated to be about 110,000 tons per annum. In 1937-38 the total imports of paper and boards from abroad amounted to about 145,000 tons. The present *per capita* consumption of papers and boards in India may be taken to roughly about 1·4 lb. as compared to 150 lb. in the U.K., 175 lb. in Canada and over 300 lb. in the U.S.A. Cheap and low-grade writing and printing paper will therefore be required in enormous quantities, for the spread of literacy among the masses; for too long has India remained indifferent to the spread of mass education.

Newsprint

The acute famine of newsprint during the second world war has amply demonstrated the necessity of making the country, as soon as possible, independent of foreign imports of newsprint. It is satisfactory, therefore, to learn that recently, bulk quantities of groundwood pulp from the paper mulberry and bleached bamboo pulp were prepared at the Forest Research Institute and converted in one of the Indian mills into reels of 'mechanical' paper. The printing trials on a high speed rotary press have proved satisfactory. In view of the great difficulties of utilizing coniferous woods which are most suitable for the production of mechanical pulp, investigations are in progress on the possibility of utilizing soft woods of the broad-leaf species.

The demand for paper of all kinds is bound to increase in the coming years and investigations on the possibilities of manufacturing various types of paper and the suitability of particular raw materials for the purpose are very necessary. To give a few examples of India's requirements : grease-proof papers, high wet strength papers, cable insulation papers, water-proof papers, surgical cotton and boards for heat and sound insulation, panelling, furniture, partitions and for the bodies of vehicles. It may be possible to manufacture the latter from saw mill and forest wastes, jungle grasses, and from hard wood which, at present, finds no use.

Technical training

A proposal is under consideration in the Research Institute, to organize regular and advanced courses of training in pulp and paper technology for a sufficient number of young men, who would in due course be able to fill in supervisory and managerial posts in paper mills. The paper industry has so far depended on foreign experts to man responsible positions in the mills and the admission of Indian students in well-known technological foreign institutions has been extremely difficult. Training within the country on advanced standards, is preferable to the more expensive method of sending students abroad. The present proposal is to train about 15 students per year but the facilities will have to be expanded greatly to meet the growing demand for trained technical personnel.

The above survey indicates where India stands *vis-a-vis* the other countries of the world in regard to the utilization of her forest wealth. The comparison with some foreign countries especially those which are in the vanguard of industrial progress, reveals the tremendous gap between them and India in respect of forest utilization. However, it is important to bear in mind that given proper direction, the utilization of India's forest wealth can develop into among the most promising industries of the country. With an Indian Minister in charge of Agriculture, an Indian Secretary in charge of the Department, and for the first time since the inception of Forest Research Institute, an Indian at the head of the Research Institute, planning for the growing needs of the country can be on more comprehensively national lines than ever in the past. (*P.I.B.*)

CATTLE DISEASES IN BOMBAY PROVINCE*

A DIAGNOSTIC survey of tuberculosis, Johne's disease and contagious abortion has been conducted and all the three diseases have been found to be widely prevalent in the province.

The incidence of tuberculosis has been regarded to be fairly high and is found to be higher in dairies than the cattle-breeding institutions. In 1934-35, its incidence was as high as 20·9 per cent. In some places the affected animals were segregated and other precautions were also taken.

Contagious abortion has been found to be widely prevalent in several districts. This disease has been confirmed by agglutination test. Brucella organisms in pure cultures were isolated for the first time in India in synovial fluid collected from a cow suffering from synovitis of the knee. Calfhood vaccination against the disease has been performed with encouraging results. Treatment in early years with 'Contramine' failed but 'Yaten abortion vaccine' and 'Prontosil' gave satisfactory results. It was noted that majority of cases aborted repeatedly at certain institutes and villages. Abortion in certain cases was also found to be due to non-specific causes and was controlled by feeding 'Churn' of I.C.I.

In 1940-41 a virus-absorbed aluminium hydroxide vaccine was prepared under the direction of Indian Veterinary Research Institute, Mukteswar, for use against foot-and-mouth disease. Immunity conferred by it was found to be effective for one month.

In early years work on rinderpest was done and as a result of that work vaccination with GTV vaccine has been adopted as a routine measure. On tests performed over several years the vaccine has been found to confer immunity for more than five years. A reduction in the milk yield of 46 per cent was observed but it returned to normal gradually. Large number of animals have been tested against Johne's disease.

Trypnosomiasis was investigated in early years and Naganol was found to be effective as a curative and preventive. Outbreaks of Bovine surra were successfully controlled with tarter emetic treatment. 'Anthiomaline' was found to be better because it can be used both intramuscularly and intravenously. DDT has been successfully used for fly control.

Theileriasis among calves was investigated with special reference to identity of the causative parasite and the transmitting tick and control measures were undertaken by making tick-free paddocks.

A helminthic survey has also been carried out and all important genera of helminths have been found to be present in this province. A good deal of attention has been paid to the nasal granuloma and verminous pneumonia. The former has been treated successfully with tarter emetic and 'Antimosin'. The disease has been successfully controlled by the above treatment and by destroying snails in water tanks with copper sulphate.

In calves, sheep and goats outbreaks of diarrhoea and debility were attributed to *H. contortus* and Oesophagostomes.

Heavy tick infestations among cattle were investigated and Cooper's cattle dip and Tick grease against ticks were recommended. The extent of the infestation was recorded.

Night blindness was observed in cattle and was attributed to feeding on cotton seed. Feeding of green fodder cured the affection.

Various species of biting flies were collected from various places in the Bombay Presidency and were later identified by the Indian Veterinary Research Institute, Mukteswar.

Dermititis in young buffaloes has been treated with encouraging results by the administration of sterile sea-water.

Cases of sterility and late maturity were observed in North Kanara and East Khandesh Districts and were attributed to malnutrition.

In 1943-44 it was observed that dairy cattle came on heat when they were fed on yeast. (I.C.A.R.)

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* Summary of the work done by the Disease Investigation Officer, Bombay, during 1932-47.

Across the Borders

BEE RESEARCH

By COLIN G. BUTLER

ALTHOUGH honey-bees have been kept in apiaries for hundreds of years and have roused the interest and active curiosity of many people, serious bee research, like so many other branches of biological research, really only commenced about thirty years ago. Bee research has, perhaps, been unique in that it has behind it a great mass of data, accumulated throughout the centuries, relating to the behaviour, anatomy and management of honey-bees. Much of this information has been found to be of great value, but fifteen or twenty years have had to be devoted primarily to an attempt to sort out the good from the bad, the true from the false, and to discover the fundamental facts underlying the proven practices of successful bee-keepers. This has been a necessary prologue (and it must be realized that it is not yet fully completed) to the work which will, I am confident, lead to great advances in bee culture during the next quarter of a century. It also helps to explain why more rapid advances have not yet been made. We stand upon the threshold of a new era of bee research and bee-keeping now that much of both the good and the bad in the bee-keeping practices of the past has been disclosed and now that it is realized that the honey-bee has an indispensable part to play as a pollinating agent rather than as a mere producer of honey and wax.

Although I do not wish to be thought to be making any prophecies, I should like to discuss some of the current trends of thought amongst bee research workers and some of those lines of investigation which appear to be of particular interest and promise.

Artificial insemination

The development of first-class honey-producing strains of bees has, in the past, been seriously hampered, indeed, rendered almost impossible in most places, by the absence of any known method of securing the insemination of a given virgin queen bee by a selected drone of known parentage. As long ago as 1789 Huber discovered that queen honey-bees mate outside the hive and free in the air. Ever since then sporadic attempts have been made to cause queens mate in some confined space, or tethered, or in some other way more or less under control. Indeed, Huber himself describes how he tried, without success, to inseminate a queen instrumentally at the suggestion of his friend Bonnet, whom, it is said, suggested to him that 'it would be suitable to try to fecundate a virgin queen artificially by introducing within the vagina, at the end of a hair pencil, a little of the prolific liquid of the male'. In 1923 Quinn reported that he had succeeded in inseminating a queen by opposing to her genitalia the genitalia of a drone in such a manner that, on causing the latter to ejaculate by applying pressure to his abdomen, his penis entered the vagina of the queen and remained there, much as in the case of natural mating. This technique of 'hand-mating', as it has been called, was practised with some degree of success by various workers, particularly by Quinn's grandson, Harry Laidlaw, but was proved to be unreliable and has been discarded. In 1926, however, Watson demonstrated convincingly that it is possible to inseminate a queen by the use of a small glass syringe but, although Watson himself, and others, particularly Nolan, obtained some promising results with this technique and were able to carry out certain breeding experiments, it too was found to be unreliable. Only a small percentage of the queens operated upon produced fertile eggs, and then only sparingly, and after a long period.

It was not until about 1944, when Laidlaw published details of his discovery of a hitherto overlooked valve-fold in the genitalia of the queen, that further progress along this line became possible. From that time, progress has been rapid. Thanks to the work of Mackensen and Roberts in the U.S.A. who have developed a technique whereby semen from the drone is passed beyond the valve-fold and directly into the median oviduct of the queen, it is now possible to produce a fertile queen by means of artificial or, more correctly speaking, instrumental insemination, which is in every way as good as a naturally mated queen. Such a queen is perfectly capable of heading a large honey-producing colony for a full year or more with complete success. Not only does this technique enable us to produce queens, drones, and worker bees of known parentage, but it also has the important advantage that such fertile queens can be produced easily and regardless of weather conditions, whenever virgin queens and drones can be obtained. Furthermore, the great majority of the fertile queens inseminated by means of the latest elaboration of this technique commence to lay within ten or twelve days of emergence as adult insects. Indeed, so successful is this method of producing fertile queens when the necessary apparatus and skill in its use are available that the Federal Research Workers in the U.S.A. are believed to have abandoned completely their queen-mating apiaries and now rely entirely upon queens inseminated instrumentally to head the hundreds of colonies employed in work on honey production, disease resistance, etc. at their various strategically placed Bee Culture Laboratories. None the less, it will be obvious that very delicate apparatus, a good binocular microscope, and other laboratory facilities are necessary, as well as a good deal of practical experience before one can hope to inseminate queens successfully. For these and other reasons, I think there is no likelihood of this technique being adopted by many of our commercial bee-keepers thus rendering their mating apiaries redundant. I am quite certain, however, that this technique, properly applied by skilled people working on a definite programme of strain improvement, can result in a few years in very greatly improved strains of bees being available to bee-keepers in this country. It is my view that bee-breeding and strain improvement is and is likely to remain, primarily a matter for research centres. For the good of the industry, and so that the most rapid progress possible may be made, it is greatly to be hoped that all centres where work of this kind is taken up will keep in very close touch with one another and work upon an agreed and carefully coordinated programme.

Breeding policy

I hope that it will be possible during the next two or three years to bring together at various centres a collection of perhaps a dozen of the world's best honey-producing strains of bees. From the best of these strains a number of lines will have to be bred and most carefully maintained by means of artificial insemination.

Since it is already known that the inbreeding necessary to purify these lines will lead to a serious reduction in the viability of the eggs and young larvae produced by the queens of these lines, it will be necessary to mate a drone of one line of strain with a queen of another line of the same strain in order to produce a queen of this strain for use in a honey-producing colony. It will, therefore, be desirable to develop and maintain at least half-a-dozen of each strain selected. Once a number of inbred lines of various strains have been developed it will be possible to embark upon a definite programme of work in an endeavour to develop better strains and to study such matters as hybrid vigour. It is very probable, indeed, that a hybrid worker bee produced by crossing an inbred line of one strain with an inbred line of another strain will prove to be a better honey gatherer than workers from either of the strains. Some hybrids will, of course, be much better than others and, once the most desirable crosses have been discovered, they can be produced as desired, provided, of course, that the parent strains are maintained. If we desire to make use of these hybrids the inbred strains will have to be maintained indefinitely and arrangements made whereby the hybrids can be produced and distributed in numbers. It may, for instance, be possible to obtain the active cooperation of our commercial bee-keepers and to supply them with breeder queens and drone-producing colonies from which they can rear queens which will produce the desired hybrid workers. It seems clear to me that research workers, honey farmers, queen breeders, and amateur bee-keepers will have to get together and agree upon some coordinated plan of work, if we are to obtain the very real advantages which this new technique of instrumental insemination offers to us.

Bees as pollinators

It is my considered opinion that this new technique of artificial insemination which allows of the production of first-class queens is one of the most important advances so far made in research work on the improvement of strains of bees, not only for honey production but also for wax production, and also for that still more important purpose, the pollination of the flowers of specific seed crops. There seems to be little doubt, for instance, that some strains of honey-bees tend to visit red clover certainly for pollen, and probably also for nectar, much more frequently than do bees of other strains of the same race. It should now be possible, and it is undoubtedly desirable, that strains of bees should be selected and developed for such definite purposes as the pollination of red clover or alfalfa. We may, perhaps, also be able to select definite strains for the production of clover, heather, or any other definite kind of honey. If artificial insemination and controlled hybridism can do for bee-keeping anything approaching what they have already done for animal and plant breeding, they are surely worthy of our very first efforts.

Comb space

There is one aspect of such a programme of stock improvement which will require most careful consideration. All the really first-class honey-producing strains of bees that I have so far come across, both in Europe and in North America, have been very prolific breeders and require adequate comb space in which to develop their large brood nests. Unless this important fact is fully appreciated, by these bee-keepers who wish to make use of these strains of bees, which, I hope, will soon become available to all, many of them will certainly not take full advantage of the potentialities of these strains and, even in good districts in good seasons, will not obtain the large crops of honey that are possible. It would seem, therefore, that it will be necessary to include in any stock improvement programme a scheme whereby bee-keepers may learn how to obtain the best results from prolific queens and how to handle much larger colonies than those that they have hitherto been accustomed to manipulate. Possibly, demonstration apiaries maintained by bee-keeping instructors may help to solve this problem. It is of little benefit to make queens of really good strains available unless the purchasers of such stock know how to make proper use of them.

Disease resistance

In the U.S.A., Dr O. W. Park, Mr. Frank Pellett and other workers, have clearly demonstrated that certain strains of bees of Italian and other races show a remarkable degree of 'resistance' to infection with American Foul Brood Disease. It has been shown that queens of these so-called 'resistant' strains produce workers that are excellent house-cleaners and very quickly clear out any larvae, whether in the ropy or scale stage that have died in the hive of A.F.B., or have been introduced in order to test the 'resistance' of their colonies experimentally. These bees do not possess resistance to this disease in the sense that their larvae are immune to it; their larvae can become infected with *Bacillus larvae* (the bacterium responsible for A.F.B.) and die, but the strongly developed house-cleaning propensities of these strains of bees result in the diseased larvae being thrown out at an early stage and the chance of spread of the disease within the colony is lessened. Unfortunately, however promising this work sounds, those strains of bees that have been found, so far, to possess a high degree of 'resistance' to A.F.B. are both bad tempered and poor honey producers. Perhaps even more serious is the fact, that in some cases at least, they appear to be particularly prone to attack by European Foul Brood. I am convinced that a great deal of careful breeding work and testing of the resulting bees under various climatic conditions still remains to be carried out before we can expect to make any really useful advance in the control of A.F.B. by the use of strains of bees that show 'resistance' to this disease. Now that 'resistance' to

A.F.B. has been clearly demonstrated to be a genetical, an hereditary character, it will probably be wiser and more profitabe to search for 'resistance' amongst some of our more promising honey-producing strains of bees. Such 'resistance' must be present to some degree and only needs searching out. It is better to do this than to attempt to tackle the problem the other way, by setting out to improve the honey-producing capabilities of one of the 'resistant' strains already available. A considerable amount of time has already been spent in attempts to improve the honey-producing capabilities, and the temper of bees of some of these strains, without any very promising results having been achieved. This is, of course, yet another problem in which the technique of artificial insemination is likely to prove of very great value.

Disease control

Other attempts to gain control over American Foul Brood have been made by feeding various drugs of the sulphonamide group in syrup, both to colonies of bees infected with this disease and also to colonies that have been exposed to infection. Unfortunately, what I regard as very rash and hasty claims for the elimination of A.F.B. from colonies of bees by the use of such sulphonamides as sulphathiaozole have been made by a number of people both in the U.S.A. and in this country. Much publicity, which I regard as being very premature, has been given to this method of eliminating the disease from a colony of bees. During the past few years we have been carrying out, at Rothamstead, and, latterly, at various widely scattered centres, a series of experiments designed to test such important things as the relative efficiency of various sulpha drugs; methods of applying these drugs to infected colonies; the dosage required under different circumstances, etc. As a result of these trials we already know, quite definitely, that, under favourable conditions, the majority of colonies that are infected with A.F.B. will respond in a satisfactory manner to treatment with various sulpha drugs. But we also know, equally definitely, that some colonies that are infected with this disease will not, apparently, respond to treatment at all. The reason, or reasons, for this are at present unknown. In yet other cases in which, after treatment has been completed, all traces of the disease have disappeared, it has reappeared again some weeks later.

So far, we have no satisfactory data to show just how these drugs work when they are successfully applied to a colony of bees suffering from A.F.B. The diseased larvae, whether they are still in the 'ropy' stage or have dried up into 'scales' just disappear, first from the centres of two or three combs in the brood-nest, next, as the size of the brood-nest increases, throughout these two or three combs, then from the centres of the next couple of combs, and so on, until not a scale or dead larva remains anywhere in the brood-chamber. It is, of course, the bees themselves that do this job of house-cleaning, being stimulated to do so, apparently, by the sulpha drug, which appears to increase their energy. But, although the bees themselves throw out the diseased larvae, many millions of spores of *Bacillus larvae* must still remain in the hive, hidden in the honey, wax, etc. ready to cause trouble later on. It has also been found that these drugs do not prevent germination and growth of the spores of this bacterium in vitro, nor do they inhibit the formation of spores by this organism. It appears difficult, therefore, to explain some of the promising (I would not care to call them anything more than this) results that have been obtained with these drugs in the apiary. Dr Sturtevant, the great American authority on brood diseases of the honey-bee, has suggested that germination of the spores of *Bacillus larvae*, when they have been fed by a nurse bee to a larvae with its food, is retarded for a few hours, and this time is sufficient to carry the larva over the very limited period of its life during which infection can take place. Whether or not this is the true explanation, it is becoming increasingly clear that this method of control is certainly not reliable as it stands and that one cannot, under present circumstances, feel justified in recommending the use of these drugs to bee-keepers. Indeed, particularly as the treatment is rather expensive, it is doubtful whether it is ever likely to prove to be that boon to bee-keepers which early statements by its sponsors led us to hope might be the case. In the present state of our knowledge, it would, in my opinion, be a very grave mistake, to allow treatment of an infected colony with a sulpha drug as an alternative to total destruction, particularly in England and Wales where destruction is now compulsory. Where a policy of destruction of all infected bees and combs, and disinfection of the hives has been energetically and faithfully carried out during the last few years, such a high degree of control over this disease has been obtained that it would be foolish to run the risk of losing ground in any attempt to save the lives of a few colonies of bees.—Reproduced from *Scottish Agriculture*, January 1948.

NEW VARIETY OF COTTON

A NEW variety of cotton known as Mysore-American V. has been evolved by crossing Co. 2 (a Cambodia pure strain) which is much superior to local Doddahatti grown in the northern and central tracts of the Mysore State since 1850.

M.A.V. cotton grows well both under irrigation and rain-fed conditions. It is fairly resistant to Red Leaf Disease unlike Doddahatti which is very susceptible to it. The plants are characterized by broad leaves and big bolls which open well. Its staple length is 1⅛ in. and its ginning outturn goes up to 35 per cent. Its cotton spins up to 36's Highest Standard Warp Counts.

The yield varies with the type of cultivation from 400 to 1,350 lb. of kapas per acre.

Home Gleanings

PETHA : ITS CULTIVATION AND ECONOMIC USES

By B. N. AGNIHOTRI

PETHA (botanical name—*benincasa cerifera*), a popular fruit since time immemorial, has been cultivated in almost every part of India under different local names such as *petha*, *chal kurma*, *gol-kaddu*, *kumra*, *kudimah*, *kondha*, *phuthia*, *khabha*, *bhunja*, etc. The English equivalent of *petha* is white gourd melon.

History

Even of late there was a belief that the plant did never exist in a wild state. This has now been found to be incorrect. In fact, this erroneous belief appears to be due to confusion caused by different botanical names for the wild growing species by various workers.

According to DeCandole it is a native of Japan and Java. The cultivation of *petha* in China dates from the remotest antiquity. It is reported to have been cultivated in some parts of Europe but its cultivation was given up later on. It is difficult to say as to when *petha* cultivation started in India, but there is reason to believe that it must have been here for a very long time.

Uses

The fruit is used as a vegetable and forms also an ingredient in curries, but is rather watery and tasteless, if cooked alone. The fruit is largely used for making confection which consists of the pieces of this gourd coated with sugar. The fruit has been very much prized because of its medicinal properties. According to Watt the fruit possesses alternative and styptic properties and is popularly known as a valuable anti-mercurial. It is also said to have cooling effect. Owing to its tonic*, nutritive and diuretic value it is a specific for haemoptysis and other haemorrhages from internal organs. According to the authors of old Sanskrit works it is also useful in insanity and other nervous diseases: the fresh juice being given either with sugar or as an adjunct to other medicines. Watt further quotes a number of authorities who recommend it as a medicine for various other ailments such as pthisis in the first stage (as a base to administer pearl shells), pulmonary consumption, piles and dyspepsia, syphilitic erruptions (as vapour bath) and diabetes.

Description

The plant, an extensive climber with trailing habit, belongs to the natural order Cucurbitaceae sub-family Cucurmerineae. It is an annual with a large pumpkin-like fruit which is fleshy, oblong or ovoid cylindrical one to one-and-a-half feet, hairy and bright green when young but becoming smooth when ripe and covered with bluish-white, waxy bloom.

Cultivation

It is, as a rule, found growing on waste heaps in the vicinity of the village sites or near the dwelling places; while under cultivation, it is allowed to ramble over the thatched roofs but in some localities it is commonly grown on the ground without support.

*Moisture per cent 96·0	Protein per cent 0·4	Fat (Ether extract) per cent 0·1
Mineral matter per cent 0·3	Fibre per cent Nil	Carbohydrates per cent 3·2
Ca per cent 0·03	P per cent 0·02	Fe mgm. per 100 gm. 0·5
		Vitamin B_1 I. U. per 100 gm. 21
Carotene Vitamin A units per 100 gm. Traces	Calories per oz. 4	Vitamin C (mgm. per 100 gm.) 1

* *Health Bull.* No. 23, 1937, Conoor, S. India

Climatic requirements

Petha requires a warm growing season, and is very susceptible to frost. If possible, it should be planted where it may receive full sunlight for major part of the day and where it may be somewhat sheltered from the wind. It is not grown at a height above four thousand feet.

Although *petha* is adapted to a wide range of soil, yet it thrives best on a soil which is well-drained but retentive of moisture, moderately fertile, well-supplied with organic matter and which warms up quickly. Where a long growing season prevails, heavy soil types produce the best yields, but where the growing season is relatively short, light soil types give the best results. Generally a light sandy soil should be selected for its cultivation.

Preparation of the land

As the root system of *petha* is extensive but rather shallow, the upper eight or ten inches of soil should be well-prepared and fertilized by thorough cultivation of three to four ploughings at suitable intervals to give the best results. The intervals should be so arranged as to kill maximum number of weeds. All lumps and clods should be broken up, but it is not necessary to have the soil extremely fine.

Manure

Too rich a soil tends to promote large vine growth and to retard fruiting. About hundred maunds of well-decomposed cow-dung may be sufficient for an acre. This manure is dug into the spot where the seeds are planted but this is never done if the plot was manured for previous crops.

Sowing

The seeds should be sown in patches of three or four seeds eight to ten feet apart, weeding out all but the strongest plant should the whole of the seeds germinate. Sowing may be done in the month of June or July. The amount of seed needed per acre may vary from two to two-and-a-half seers depending upon its size.

Inter-culture

Petha does not require a very great amount of inter-culture. Only light shallow cultivation will do. The ground is left clear of weeds until covered by the vines. After this is accomplished, no further attention is required.

Watering

In the early part of the growing season and when small fruits are beginning to enlarge *petha* requires ample water. Besides usual rains three to four irrigations may have to be given to raise a crop.

Ripening and harvesting

Petha starts maturing in the month of September and continues up to January depending upon the variety and local climatic conditions. The ripe *petha* develops a characteristic tinge which the grower can easily recognize after having some experience. The size of the individual fruit and its weight are other points which are also taken into account for judging its maturity. If allowed to remain on the vine too long after it is mature, the fruit becomes spongy, which renders it useless for use in the preparation of sweetmeat.

It may vary from three hundred to five hundred maunds per acre depending on the local climatic conditions and the cultural operation given.

Pest

The following pests often prove harmful to the fruit.

Red Pumpkin Beetle : The insect damages the crop in two ways. The red beetles come out and eat up the leaves of germinating *petha* which cannot make a good start. The damage by the beetles to leaves, flowers and fruits continues throughout the early growing period.

The beetles lay eggs in the vicinity of the plants. The grubs on hatching often bore into the roots and undergound portion of the stem with the result that the plants soon die.

The young plant in the beginning of their growth should be protected from insects by dusting one of the following insecticides. The dust should be put in a muslin cloth and dusted early in the morning on leaves.

(a) Tobacco dust or kerosene oil ..	½ seer
Ashes	4 seers
(b) Paris green or sodium thiosilicate	½ seer
Ashes	5 seers

Fruit fly: This is a very serious pest of *petha*. About a couple of days after oviposition, the fruits exhibit sign of attack. A white syrupy fluid oozes from the point of puncture. This finally becomes brown.

The flies are active in the field from morning till dusk. They have been observed flying actively about the leaves of plants and quickly alighting on fruit for oviposition. The eggs are deposited in the puncture. The eggs hatch into white larva. Soon after hatching maggots travel towards the core of the fruit which they slowly feed upon.

No practical method of control has been found to be completely satisfactory. It is, however, suggested that the affected fruits, as soon as noticed, should be removed and buried deep into the ground.—Reproduced from *The Indian Food Packer*, February 1948.

MANUFACTURE OF COMPOST

DURING the year 1947-48, 17,45,066 tons of compost were prepared from town and village refuse.

Of these 4,86,080 tons were produced from 566 urban centres and 12,58,986 tons from 27,950 village centres. The Central Government took over supervision of the compost schemes in 1944 and since then there has been a steady progress in the manufacture of compost.

From the trials carried out in different parts of the country it was evident that beneficial results had accrued.

Book Reviews

VETERINARY HELMINTHOLOGY AND ENTOMOLOGY

By H. O. Monnig (Published by Bailliere Cindall and Cox, 7 and 8, Henrietta Street, London, 3rd edition, pp. xviii + 427, with 275 illustrations, including 15 plates, 31s. 6d.).

ZOOLOGISTS in general and parasitologists in particular will doubtless hail the appearance of the third edition of Monnig's book which is a very handy work of reference for students of veterinary helminthology and entomology. The first print of this book appeared only thirteen years ago and the rapidity with which the third edition had to be brought out is a clear indication of its utility and popularity. The book has been written in an easy style and the additional drawings of some helminth ova and gravid segments of common tapeworms of domestic animals have been included. Some figures in the previous editions have been replaced by the author's own drawings. The information contained in Section I forms a very useful introduction to the understanding of most of the implications of veterinary parasitology. Section II is devoted to technique, the knowledge of which is indispensable to a student of parasitology. References have been made to the anthelmintics such as hexachlorethane and phenothiazine and insecticides such as DDT and Gammexane which have been successfully used in recent years. A fairly exhaustive note has been added on phenothiazine. In a short compass of the book of this size it is not expected that all helminth and arthropod parasites so far recorded from domestic animals should have received attention but the important ones have been dealt with. It is, however, felt that reference should have been made to parasites such as *Paryphostomum sufrartyfex*, *Pseudodiscus collinsi*, *Varestrongylus pneumonicus*, *Capillaria bilobata*, *Haemonchus similis* and *Leiperacanthus gallinarum*. *Parafilaria bovicola* and *Protostrongylus rufescens*, do occur in India also. The name and date ' Bhalerao, 1942 ' have been bracketted against *Cymbiforma indica*, which is evidently an error. Mention should have been made of tobacco-lime dressing against warble-fly larvae. (G.D.B.)

AERIAL WAR ON LOCUSTS

By L. ROBERTS

A SYSTEMATIC attack on the locust plague has to-day, more than ever before, become of vital importance in view of the great world shortage of foodstuffs. The danger of this pest has become increasingly clear from official statistics compiled during recent decades. These insatiable insects have destroyed crops to the value of over £83,000,000 (Rs. 110·47 crores) in the countries visited by them.

Although the necessity of a planned, organized campaign against the locust has long been recognized—Britain having taken the lead in this from the start—there was always the difficulty to be overcome that the war against this pest could only be effective if waged on an international basis.

Territory ranging from India to Africa forms, as regards locust migration, one single unit. Swarms which come out of the eggs during the summer monsoon rains in India, migrate in the autumn to Southern Persia and Arabia, while other swarms move simultaneously from Africa to Arabia. Under favourable conditions the next generation moves the following spring from Persia and Arabia to Egypt, Iraq, Palestine, Transjordan and so forth. It is, therefore, obvious that the anti-locust campaign can only be successful, provided it does not call a halt at the various State frontiers.

This international campaign is to be directed from London. In view of the decisions reached at an international conference held in Rome in 1931, of British, French and Italian entomologists, the Imperial Institute of Entomology was converted into a Central Research Station for combating the locust. This Anti-Locust Research Centre acts as headquarters in the war against locusts.

The fundamental principle applied in research is that the outbreak of a locust plague must be destroyed in the breeding stages, that is, before the tendency to swarm sets in and before a mass invasion can take place. The campaign must, therefore, be planned several months in advance on the basis of accurate predictions to enable personnel and material to be transported—often over difficult country—to the 'area of operations'.

At the London Anti-Locust Research Centre, telegraphed reports arrive every other week from all countries, giving information regarding the movements of the locusts; from London accurate forecasts are cabled once a month to the individual governments concerned, regarding imminent developments.

During World War II, a largescale action was taken against the locust in the Middle East and Africa, with the aid of troops and military equipment. This was continued after the war on a non-military basis in Arabia and East Africa. During these operations the use of aircraft proved highly successful.

In a recent issue of the British journal, *Nature*, Dr D. L. Gunn of the London Anti-Locust Research Centre, gave more fresh details concerning the adoption of aircraft in the fight against the locust. This work was carried out under the auspices of the British Colonial Office, supported by the Royal Air Force, the South African Air Force and several other organizations. Particularly valuable research took place at the Chemical Defence Experimental Station of Britain's Ministry of Supply.

The first experiments were not at all encouraging. In 1944, however, Dr J. S. Kennedy checked the results of the anti-locust flights of the British and South African Air Forces and established that the most effective chemical substance used against the locust is Dinitro-Ortho-Cresol (D.N.O.C.). But the apparatus through which the poison was sprayed was heavy and awkward to handle; moreover, the aircraft had to fly so low that the locusts were often frightened off and managed to escape the descending cloud of poison.

In the light of the experience gained, Dr Kennedy continued his studies at the Porton Research Centre. After lengthy and tedious experiments, the necessary dosage of each substance—D.D.T., Gammexane, Dinitro-Ortho-Cresol, etc.—required to kill one single locust was established, the quantity which should be sprayed to kill an insect either when stationary or in flight was determined and the vulnerability of each individual part of the locust's body was examined.

By August 1945, a detailed plan of action had been worked out. The poison was to be sprayed from an aircraft through a nozzle in drops of uniform size ; the wind was not to be avoided but taken advantage of in an accurate manner to help in spreading the sprayed poison 'rain'.

The anti-locust campaign carried out in Kenya took place under the scientific direction of Dr Gunn. It proved that the method developed at Porton, although accurate in theory had, in fact, certain disadvantages in practice. In the first instance it was found that the poison was not sufficiently strong to make working conditions economic. Further experiments were, therefore, carried out at Porton, and finally, in the summer of 1947, an improved type of apparatus and a better solution were put into use.

These improvements were incorporated in a campaign undertaken on behalf of the International Red Locust Control Organization of Rukwa Tal in south-west Tanganyika. The fluid sprayed from the aircraft, in this instance, was a 20 per cent solution of Dinitro-Ortho-Cresol in a mixture of aromatic petroleum extracts. The results surpassed all expectations. Spraying carried out at the rate of just over 1 gallon per acre resulted in 100 per cent of the insects being killed.

During the last 12 days of the campaign, some 11,000 acres of the most seriously infested areas, were freed of 95 per cent of all locusts, while carefully selected pieces of land, totalling in all about 3,300 acres, were also sprayed in like manner. Dr Gunn has, therefore, arrived at the conclusion that the results of this operation have proved beyond doubt that all the patient research work in Britain has been well worth while.

The locust swarms can, under certain conditions, be attacked successfully from the ground also and suitable machinery is now being built in Britain for this purpose. Thanks to the valuable work being done, the war against this plague, which was even feared in Biblical days, has now entered upon an entirely new phase. (*B.I.S.*)

COVER ILLUSTRATION

Potatoes growing in the Nilgiris.

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 8
AUGUST 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.8.48
2,800

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London WC 2.

INDIAN FARMING

AUGUST, 1948

Vol. IX No. 8

ADAPTIVE RESEARCH

WITHIN recent years and especially within the last one year or two scientists in India have been advised repeatedly to direct their attention towards investigations which are likely to quickly lead to practical results, for, it is said, the urgency of the times is such that the energies of research workers cannot be allowed to be dissipated in wandering over speculative fields while so much knowedge in the world is waiting to be applied in India and must be applied. It is perhaps the absence of an intelligent public interest in research, or at least in agricultural research, that accounts for that lag between the acquirement of knowledge and its application in India which has been so much talked of and so deplored by eminent technical authorities and public leaders. It is recognized that the contrast between the keenness of the Western farmers to seize and attempt to apply what facts the scientist can provide and the apathy of those in the East, who pursue their time-honoured methods oblivious of what the scientists have to offer, is due to a difference in their mental equipment. In the case of the former education was supplied early and liberally and has served to prepare a receptive mind while, in the case of the latter, it has been unobtainable, and has left the mind quite unapproachable by easy means. In the West the progressive farmer eagerly awaits the outcome of research, picks from it what he sees may be of use to himself, quickly discards what proves to be unsound for his purpose and intelligently adapts the rest so that it fits his particular requirements. He is aided by a strong State Extension Service and results of proved practical utility are through it disseminated to all agriculturists.

If that summary of the situation is correct, as we believe it to be, it suggests the advisability of questioning the soundness of the policy which would turn the scientist and the real research worker from their search after truth along the path their inclination and interest lead them, to the circumscribed road of what has come to be known as 'adaptive research'. That term signifies merely the testing of the applicability of knowledge discovered elsewhere and the devising of modifications in the method of application which would make it suitable to any particular locality. It is not suggested that the process is unnecessary or unfruitful. On the contrary we would be the first to acclaim the necessity of it. But what is questionable is the soundness of attempts to turn our research workers to it and use their laboratory for it, primarily because we consider it a misuse of their ability, in the same way as it would be to use a razor to sharpen a pencil. It is also very doubtful if the mind which can discover truth is of the kind which can devise means of applying it. And further, deplorable though it may be, the scientific research worker, almost inevitably, is not, and cannot be, in close touch with the day-to-day practical requirements of the farmer.

Our farmers may be uneducated, but neither they nor other classes of society are wholly devoid of intelligent men with resourceful minds and powers of adaptive ingenuity. We have, moreover, recruited in our provincial veterinary and agricultural services, many whose flair lies in improvisation and adaptation so that even with the limited crude equipment available to them they can take advantage of the latest scientific discoveries. It is to these we suggest that adaptive research should be entrusted. They, along with many who at present are employed in laboratories but who obviously could be far better employed in the field, should be organized into an extension service and given facilities in the field to devise means of applying what has been discovered in the laboratories.

Once a principle has been established, its truth is the same in one part of the world as in another. If the principle is understood, the intelligent man can, with reasonable accuracy, foretell what the results of its application will be under this or that set of conditions, and with the use of common-sense, a field trial can be made as a matter of course. The men we have mentioned above are probably best suited to undertake the task. Prior research, using the term in its strictest sense, is unnecessary, for all eventualities which may arise in practice cannot be foreseen and tested. It is only when the unaccountable occurs that the need for research, as opposed to investigation, is called for, and the principle must once again be put through the process of exacting scrutiny.

It is the duty of the original worker to study the facts as he finds them, to give no more prominence to that part of his work which will appeal to the public than to that part which, if it is known, may mitigate or even nullify the practical benefits which might otherwise be anticipated from it. No one knows better probably than the scientist engaged in the research just what are the aspects of it which fall into the latter category, and he, as a scientist, will make them known so that there is no misconception or under-estimation of their importance. If he fails to do this, he forfeits his good name and the confidence of the public. The staff which we have suggested should be employed in adaptive research, would accept the principles passed to them from the laboratory, try to circumvent any shortcomings associated with them, and devise means of overcoming local difficulties which prevent the application of otherwise useful knowledge.

Adaptive research so often leads to spectacular results which appeal to the uninitiated, and which are therefore immediately acclaimed. And the credit not only for repeating what has been done elsewhere, but even for the original work, so often is thoughtlessly awarded to the adaptive research workers that it cannot but be a sure temptation to a certain class of mind which is no more uncommon within the laboratory than it is outside. Adaptive research, if given undue prominence, therefore carries a grave risk of debasing the level of research of a whole country if real research talent is diverted towards it, but on the other hand, the quick results obtainable from it act as a stimulant to the public which should be beneficial rather than harmful if it is properly handled.

It should never be forgotten that it is almost invariably through what is far too often called 'merely academic work' that the knowledge has been acquired without which practical results would have been impossible. Once the principle has been discovered, intelligent investigation is still necessary if it is to be made useful, but the intelligence is of a different order to that which belongs to the untrammelled mind which boldly examines and clearly proves the existence of the hitherto unknown. 'The humdrum following up of ideas and methods already at hand—this can be charted out and scheduled by men of moderate ability. But one can no more produce fundamental and truly original work by means of some grand over-all planning scheme for science than one can produce great sonnets by hiring poets by the hour. . . . The important gaps in science are the ones we do not see and cannot foresee*'.

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*Evans, C. Lovatt (1947). The Outlook for Physiology. *The Lancet*, January 1947.

SOME PUBLIC HEALTH ASPECTS OF MILK INDUSTRY IN INDIA

IV. MILK POSITION IN INDIA AND ITS IMPROVEMENT

By K. C. SEN and H. LAXMINARAYANA

ALTHOUGH the importance of milk and milk products has been recognized in this country since time immemorial and although the cow has been intimately connected with every phase of national life, the existing condition of Indian milk industry is extremely unsatisfactory. The total output of milk is disproportionately low considering the immense cattle wealth of the country and there is no equitable distribution or profitable exploitation of milk that is produced. As a result, the *per capita* consumption of milk and milk products is estimated to be hardly 5·8 oz. as against the average of 30 to 40 oz. obtained in Western countries and the minimum of 21 oz. required from the standpoint of balanced nutrition. This inadequate consumption of milk is in no small measure responsible for the high infant mortality figures, the low resistance to disease and the appalling conditions of ill-health among infants, nursing mothers and others in this country. In addition, the quality of milk available in the market, both in respect of its purity from adulteration as well as its hygienic condition, is of a very low standard.

Among the chief factors responsible for this state of affairs may be mentioned (a) the poor productive capacity of the milch animals caused by malnutrition and improper breeding and management, (b) the concentration of milk production in isolated and distant pockets without adequate means of transporting and distributing milk to deficit areas and (c) the poor keeping-quality of milk resulting in its frequent spoilage during storage or distribution. To these may also be added, the low economic condition of the men engaged in the trade and the general ignorance as well as lack of appreciation of scientific methods prevailing in the country.

Economics of milk production in India

There is a significant fact which should be recognized in this connection, namely, the vital difference that exists between the economics of milk production in this country as compared to that in New Zealand, Australia, United Kingdom or United States of America. In most of the Western countries, milk is produced by cows on pasture. Due to the well-distributed rainfall, there is plenty of grass available throughout the year, and anything between 5 to 10 acres of land is allowed for each cow, part of which is used for fodder crop production. Dairying is dependent on good quality grass farms and consequently the milk is produced cheaply. In India, on the other hand, very little land is available for production of grass and, because of seasonal rainfall, this is available only for a short period during the year. As such, there is a big shortage of food leading to the curtailment of milk yield per animal and the consequent rise in the cost of milk production, specially when this is produced near the urban areas. With greater attention being paid in recent years to better methods of feeding, selective breeding and scientific management of the herd and by giving sufficient assistance and advice to the producer in these matters, considerable increase in the yield of milk is expected. Owing to the present shortage,

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malpractices such as adulteration with water and addition of substances like starch, flour, sugar and preservatives, etc. are widely prevalent, particularly in the urban areas. This is, however, essentially an economic problem. In Western countries where the general economic level of the people is high, such practices are not common. With the gradual improvement in the economic standard of the people and with a greater production of milk, the incentive for adulteration and other malpractices would gradually diminish. Further, by a strict enforcement of standards and introduction of a suitable system of payment on quality basis, the position can be brought under control.

Bacteriological quality of Indian milk

The improvement in the bateriological quality of milk presents many difficulties. The qualitative ideal to be attained in the production and supply of milk has been considered at some length in the previous articles. An examination of the present standard of milk available in the country will reveal how far below it is from this ideal and how complicated is the task of reconstructing the nation's milk supply. Milk production is mostly concentrated in the villages from where liquid milk is supplied to the consumers in the urban areas. A part of the requirement is, however, met through supplies received from a few milk men keeping their cattle in the towns, and milk shops and dairies who collect milk from various sources and distribute to their customers. There are hardly any well-organized collecting and distributing centres for supplying milk to the urban areas. Due to the unhygienic conditions of production and the questionable methods of handling and transportation over which there is no kind of control, official or otherwise, milk is constantly subject to infection in several ways. A general picture of the average bacteriological quality of market milk in India (in contrast to that of milk produced under organized and hygienic conditions) is obtained from the following Table.

The different conditions of production and handling associated with the above sources of market milk supply are too well-known to need further description, but the figures reveal to what extent they are responsible in bringing down the quality of milk and what kind of milk the consumers are getting at present. Although insanitary methods are primarily responsible for the low bacteriological quality of market milks in the country, the enormeus influence of the tropical weather in providing greater scope for contamination, particularly under dusty and humid conditions, should not be lost sight of. Accordingly there is a great fluctuation in the extent of bacterial infection from place to place and from season to season, which makes the problem of sanitary control highly complicated. The types of bacterial flora normally predominating in Indian milks are more or less characteristic of the local climatic conditions. While they generally resemble their Western counterparts in most of their properties, they are characterized by their ability to grow at higher temperatures, their greater capacity to flourish under adverse conditions, and the remarkable speed in bringing about biochemical changes leading to the quicker deterioration of milk and milk products.

TABLE I

Bacteriological quality of market milk in Bangalore

Source of production or supply	Plate count per ml.	Methylene blue reduction time (hrs.)
Indian Dairy Institute Farm (Individual)	.. Below 50,000	5½ to 9 and over
,, (Herd)	.. ,, 100,000	4 to 5½
Domestic cows	.. ,, 100,000	4 to 5½
Town cattle stables	.. 200,000 to 5,000,000	2 to 5½
Village milk	.. 500,000 to 10,000,000	1 to 4
Travelling milch cows	.. Below 500,000	Above 4
Milk hawkers	.. 500,000 to 5,000,000	3
Town dairies	.. Over 1,000,000 .. (maximum 90,000,000)	2

Influence of climate on life of milk

An important point to be borne in mind while considering the quality of milk in India, is the influence of the tropical temperatures on microbial activity and the consequent keeping-quality of milk. In Western countries, the low temperature provides a natural system of refrigeration and even the worst types of milks will have an appreciably long keeping quality compared with the average quality milks in this country. For example in Norway, raw milk can be kept for three or four days under ordinary condition without much deterioration. The usually high temperature prevailing here favours a very rapid multiplication of bacteria and even the cleanest available milk with a low initial bacterial count has a comparatively shorter life. This great difference in the natural life periods of a food like milk in Western countries and in India is clearly shown by data presented in Table II.

TABLE II

Influence of atmospheric temperature on the keeping-quality of milk

Storage temperature	Initial plate count per ml.	Keeping-quality* (positive boiling test) (Hours)		
		Raw	Pasteurized	Boiled for 5 min.
England	16,000	70		
(Average summer	126,000	61	..	..
temperature)	500,000	54	..	..
15·5°C.	75,000	34	..	..
(Maximum temperature) 17·5°C.	1,000,000	18½	..	..
Bangalore	15,000	26	..	..
(Average winter temperature) 21° to 22°C.	56,000	18	..	..
(Average summer	21,000	15	24	18
temperature)	213,000	9	15	18
25° to 27°C.	510,000	9	19	22
	46,000,000	4	9	18

*The figures are taken from different experiments for comparative purposes.

Not only does the unfavourable Indian climate provide greater scope for contamination, but it also accelerates bacterial growth leading to the premature spoilage of milk. The trouble is further accentuated by lack of proper means of transport or cold storage facilities, the long distances involved and the economic conditions of the people. The cumulative effects of all these factors are clearly exhibited in the case of bulk milks handled by the collecting and distributing centres in the towns, which are made up of supplies received from diverse sources, and are accordingly of the lowest standard. Milk belonging to this category can seldom be preserved in raw condition for more than four to five hours in the consumer's house, while the better types can at best be maintained for some three to four hours longer.

Improvement of keeping quality by heat-treatment

There is very little prospect of improving the quality of such milks to any substantial extent by mere heat-treatments. Pasteurization, which has proved so valuable in Western countries in increasing the keeping-quality of milk, does not seem to be very effective in the case of Indian milks. Firstly, the excessive microbial population does not permit of efficient pasteurization being carried out and secondly, the preponderance of heat-resistant flora in them, which survive the process and find favourable opportunities for development sooner or later, is a serious factor to reckon with. Sufficient evidence is available from the results of research work carried out at the Indian Dairy Research Institute to warrant the conclusion that the incidence of heat-resistant micro-organisms in our milks is generally high and many of them are endowed with extraordinary powers of resistance to high temperatures. It has thus been found that the average keeping-quality of pasteurized farm-produced milk varies from 18 to 20 hours while that of market milks is below 12 hours. Furthermore, the cooling and storage of pasteurized milk at low temperatures (below 40°F.), which is indispensable for preventing the growth of the surviving flora, is an expensive proposition under the tropical conditions here. Accordingly the general adoption of pasteurization in this country as a means of improving the keeping-quality of milk for withstanding long distance transport or prolonged storage may be found impracticable not only on account of its expensive and elaborate nature, which does not fit in with the present Indian economy, but also because of its inadequate sterilizing effect. A more suitable form of processing milk, based on a proper understanding of the nature of bacterial flora predominating in Indian milks and adapted to the peculiar climatic and other conditions of the country, is necessary. This is one of the important problems under investigation at the Indian Dairy Research Institute, Bangalore.

Boiling which is the primitive and simple method of processing milk in India, is undoubtedly more effective than pasteurization as far as bacterial destruction is concerned. But the useful life of milk is not thereby prolonged to any considerable extent due to the survival and subsequent growth of many spore-forming organisms, like *B. subtilis*, *B. mycoides* and *B. ablo lactis*, which are invariably present in the inferior grades of milk and which are able to withstand even boiling for half an hour. Some of them are able to develop at low temperatures (20° to 60° C.) while others can be active at high temperatures (50° to 60°C.). Results of experiments at the Indian Dairy Research Institute reveal that the average life of boiled milk at ordinary temperatures (30°C.) varied from 14 to 18 hours and it is much less when room temperatures go higher or when the heated milk is stored in unclean vessels (particularly mud pots). Re-heating of the milk after 10 to 12 hours has resulted in prolonging its life for at least another 12 hours because the surviving spores would germinate in the interval and become less resistant to heat when the second processing is done. It is also common experience that milk produced and handled carelessly and exposed to warm temperatures too long often coagulates at the first application of heat due to the high degree of souring or protein degradation already brought about in it by bacterial growth. The initial quality of milk, particularly its freedom from spore-forming types, appears to be the deciding factor in determining the life of milk in the consumer's house.

The above considerations bring out the important fact that the only satisfactory solution for obtaining a high quality milk, whose keeping properties as well as safety for human consumption can be efficiently protected by a suitable heat-treatment, lies in the production of the cleanest possible milk initially and minimizing its subsequent contamination during handling, transport or distribution. The production of such a milk necessarily involves the exercising of control over all operations connected with the production and handling of milk from the cow to the consumer and the imposition of the highest standards of cleanliness at every stage.

Measures for improving the milk position

Bacteriological control of milk thus forms a problem of great significance to our country and unless sufficient attention is paid to this aspect, no real improvement in the milk position can be achieved. There was no problem of milk supply or need for such organized official control in the past because civilization was mostly centred round the villages and practically every householder was maintaining dairy animals for his domestic requirements. With the advent of modern conditions of living, the situation is changed. There is greater concentration of population in urban areas and cow-keeping no longer forms a cherished domestic enterprise even in villages. It is, therefore, necessary to recognize the changed conditions and regulate the production and distribution of milk to meet the present day requirements. Similar conditions existed once upon a time (say in 1900) even in the United States and England, but the people there were quick to appreciate the changing circumstances and kept pace with the developments taking place in modern science. By a proper coordination of the various activities involved in the production and marketing of milk under centralized control and by an official enforcement of adequate standards of hygiene at all stages of milk handling, they have been able to build up a satisfactory milk supply in their countries within the space of some 40 years. It should not be difficult to bring about a similar improvement in this country in a much shorter time, since we have the experience of these countries behind us and there is a vast amount of scientific and technical data accumulated on the subject for guidance.

In this connection there are two salient factors to be borne in mind. One is the special importance attached to milk and milk products in the vegetarian diet of the vast population of this country and the significant position of the milk industry in the very economic structure of the nation. Apart from the importance of milk itself to public health, milk production is closely connected with the development of agriculture which forms the key-stone of India's prosperity. Accordingly, one of the principal aims envisaged in the post-war developmental plans for the country should be the organization of the dairy industry on an efficient basis for supplying more and better milk to the people and for improving the economic position of the farmer. Secondly, the great differences in the conditions of Western countries and India have to be taken into consideration in undertaking any measures based on foreign experience. Some of the outstanding differences noticeable in so far as the quality control of milk is concerned, have been indicated in the foregoing paragraphs. It is, therefore, evident that while the problem of improving the milk industry should receive consideration on the highest priority basis, the remedies adopted in Western countries cannot be imported here wholesale without modifications suited to local needs and conditions. In drawing out any developmental programme for the improvement of market milk supply, these important factors must be given sufficient consideration.

Furthermore, the immediate introduction of any full-fledged market milk control with all the sanitary measures and public health safeguards, as are followed in the United States or England, may not be productive of useful results. At present milk production in this country is in a chaotic and scattered condition. There is no uniformity or any standard of hygiene in the methods of the trade and the business is concentrated in the hands of ignorant and sometimes unscrupulous producer-retailers and selfish middlemen. There are a number of large and small dairies operating in some of the principal cities of the country. Most of them are, however, just functioning as mere collecting depots. They collect milk from the villages round about and distribute it to their customers. Only a few dairies have got facilities for processing the milk before distribution. Many of the military dairy farms have no doubt been organized efficiently, but they cater only for one section of the people and do not come into the picture of market milk production. There is no sort of bacteriological or sanitary control over the activities of the trade. This system of milk production and marketing will have to be reorganized. The individual producer-retailers and the small middlemen must be eliminated as much as possible and brought into some form of cooperative association for dealing with the matter on a collective basis. Largescale dairy farms, creameries, dairies or distributing concerns must be encouraged to be established on up-to-date lines in areas of high milk production and in rural areas as near the consuming centres as possible. The present practice of villagers bringing and selling small quantities of milk in the open market or direct to householders in the town must be discouraged as no control can be exercised in such cases. Similarly the town *gowalas*, who maintain a few animals in the heart of residential areas for catering to the requirements of the towns-people, as well as the practice of bringing cows to the consumer's house for milking before his door should be discouraged. In the latter case, there is an imaginary satisfaction on the part of the householder that because the milk is produced and delivered in his presence, he is getting pure milk. Even under such circumstances there are several ways in which the cunning milk vendor adds water to the milk. This was revealed in one of the investigations carried out at the Indian Dairy Research Institute. Out of 50 samples of milk collected in this manner, some 40 were found to be heavily adulterated (20 to 50 per cent of water). The milk produced in the villages should be collected by some central agency, preferably a co-operative organization in which the producers also should hold some interest, and brought to the town for distribution, which necessitates the development of suitable means of transport. This system will save much time for the producer to attend to his farming and breeding operations and also will cheapen the cost of production considerably. A suitable form of heat-treatment at some stage of milk handling becomes essential for prolonging the keeping-quality of milk and ensuring its safety. The establishment of city milk stores with adequate cooling arrangements (preferably as a cooperative organization of the consumers or run under municipal auspices) to sell milk in retail to the people as and when they require, would be needed. Since India consists mostly of villages, the people living in the rural areas should also be taken into consideration in organizing the milk supply. Sufficient milk should be produced in the villages for meeting the requirements of the producers and village people as well as the city population nearby. In the case of consuming centres situated in deficit milk areas and far away from milk pockets, the problem becomes more complicated in view of the tropical climate, lack of suitable transport facilities and impracticability of introducing largescale refrigerated transport systems. The only solution consists in the conversion of surplus milk in milk pockets into dried or evaporated milks and transport them to milk-deficit areas.

It is only after the production and supply of milk has been organized in some such manner as indicated above and collective methods of milk trade are established, it will be possible to introduce a rational milk control policy and work it out successfully. Taking into consideration the various difficulties existing in this country and recapitulating the series of developments that have culminated in the establishment of a sound milk industry in the Western countries, it is clear that the problem of improving the milk position, from the quantitative as well as qualitative view points, will have to be approached from the following main angles:

(1) *More intensive production of milk:* This involves firstly, the concentration of milk production exclusively in rural areas and secondly, the adoption of better methods of breeding, feeding and management for enhancing the productive capacity of the animals. In this connection, the introduction of artificial insemination for securing the services of approved bulls to the small dairy farmers at a reasonable cost and the intensive cultivation of fodder crops for providing sufficient food to the cattle appear to be indispensable steps. Both these objectives can, however, be achieved only by collective efforts through the agency of cooperative or other organizations, since the small producers cannot afford to act individually in the matter. It is also essential that sufficient economic stimulus should be provided to the producers for giving them an incentive to produce more milk. This necessitates the provision of suitable arrangements for the profitable disposal of their produce and supply of feeds and other materials required by them at a cheap cost.

(2) *Hygienic methods of milk production and handling:* The production of clean milk free from physical impurities and bacterial contamination is of the utmost importance to the producers as well as to the consumers. The producers and other personnel engaged in the milk trade must be educated in the fundamental principles of milk hygiene and clean milk production and suitable arrangements made for providing technical assistance and guidance to the trade in the matter. As an incentive to clean milk production, the producers must be enabled to get sufficient returns for their labours by the offer of higher prices for quality.

(3) *Protection of milk from infection by pathogenic organisms derived from animals or man:* The first important step in this direction consists in the introduction of a programme for efficient disease control among dairy herds not only for producing milk free from disease germs, but also saving the producers from enormous losses due to loss of milk or cattle caused by diseases like mastitis, tuberculosis, contagious abortion, etc. The adoption of prophylactic measures on the farm, prevention of unhealthy persons from handling milk and protection of milk from infection during its handling and transport are necessary corollaries.

(4) *Introduction of efficient methods of processing milk for ensuring its safety and prolonging its keeping quality to stand long distance transport:* Such methods will have naturally to be based on the results of coordinated scientific research and practical application with reference to Indian conditions. At the same time, problems connected with the economic manufacture of various milk products and conversion of surplus milk to condensed and dried milks for feeding milk-deficit areas have to be examined.

(5) *Organization of collective methods of milk production, marketing and utilization:* In this connection, the establishment of producers' societies, milk-collecting and distributing centres and creameries on a cooperative basis appear to be favourable for the speedy organization of the trade on a collective basis. This will facilitate the introduction of up-to-date technological methods in the handling and utilization of milk and the sanitary control of market milk. The provision of suitable roads and means of transport and establishment of processing and distributing depots and consumer's stores in towns and cities are also to be considered.

(6) *Dairy inspection and market milk control:* Suitable legislative measures for the public health control of market milk production will have to be enacted together with the formulation of chemical and bacteriological standards for quality control of market milk and

provision of necessary inspectorial and advisory services for enforcing the official regulations as well as giving advice and assistance to the trade.

All these aspects have to be tackled simultaneously and given equal attention, since each has an important bearing on the other, while at the same time possessing a separate importance of its own. The successful implementation of any improvement policy, however, depends to a large extent on the extent of cooperation forthcoming from the trade as well as the general public. Intensive educative propaganda, by means of lectures, broadcasts, cinema, pamphlets and exhibitions should, therefore, be undertaken to make the trade as well as the general public understand the fundamental importance of good quality milk for the health and nutrition of the people and the urgent need to reorganize the existing methods of milk production in line with other progressive changes taking place in the country. Once a coordinated plan of the kind suggested above is decided upon and followed up in a concerted manner, there is no doubt that within the course of the next few years, considerable improvement in the health and productive capacity of the dairy animals and in the quantity and quality of the nation's milk supply could be achieved.

COOPERATIVE DESIGNS NEW MILK VAN

A NEW semi-trailer totally-enclosed insulated motor van, designed to carry 2,300 gallons of pasteurized milk for a South Australian dairy cooperative has been designed by the manager of cooperative, and built in Adelaide.

Even on the hottest day, milk carried in the van will travel from dairy farm to city consumer at a temperature of not more than 39 degrees F. The vehicle will also carry Rs. 10,500 worth of cheese at a time.

The organization, the Myponga Cooperative Dairying Society has been remarkably successful. During its first year, 1937, the intake of the cooperative factory was 1,200 gallons of milk daily but this has steadily risen until, in 1947, it reached 12,500 gallons daily. The membership is now about 400 dairymen. Additions costing Rs. 210,000 are being made to the factory. One of the additions is a pipeline three miles long to take waste liquid to the sea. Already a pipeline almost a mile long carries whey from the factory to the piggery, where the society keeps 800 pigs.—*Agricultural Newsletter,* No. AGN/205.

KHESARI (LATHYRUS SATIVUS) AS A HUMAN FOOD

By I. CHATTERJEE

KHESARI (*Lathyrus sativus*) also known *teora, chural, lakhori, lakh, lang*, etc. is a pulse which is eaten as *dal* over a large part of India. It is cultivated throughout India as a cold weather crop and has the faculty of germinating on land too dry for other crop. It is naturally cultivated in place of other crops when October rains fail. It forms a remarkably cheap source of food. Although it is grown all over India, its largest area is in Central Provinces and Sind (chiefly in the Larkhana District). In the Deccan it is chiefly a second crop in rice field but in Gujrat it is the sole crop of the year. In Broach it is generally raised on low-lying fields which are liable to be flooded by heavy rains, and thus become water-logged and too wet for cotton. It is also cultivated as a fodder but as it is cheap and easily grown, it is widely used by the poorer classes as bread or *dal*. This pulse has, however, an evil reputation that its eating is followed by a form of paralysis which is said to affect the lower extremeties.

Poisonous and non-poisonous varieties

Watt states that it exists in two forms, the smaller one being known in Chattisgarh as *lakhori* and the larger in Nagpur and Bhandara as *lakh*. The former is sown earlier than the latter. Its seeds are broadcast over the flooded rice fields (towards the close of the rains) while the latter is sown on rich black, dry soils, on land ordinarily devoted to wheat. According to him opinion is almost universal that, while the *lakhori* or rice-field cultivation yielded a harmless seed, the *lakh* or wheat-field crop was dangerous. The colour of wheat-land *teora* is said to be darker than the colour of rice-land *teora*.

Howard and A. Rahman[1] also state that there is a belief amongst cultivators that only the *khesari* grown in certain districts are poisonous, that grown in adjoining areas being non-poisonous. They also cite instances in which the *khesari* from low-lying rice land was considered toxic but that grown from the higher land innocuous. The views cited from Watt are also similar except that the crop from low-lying areas was considered non-toxic and *vice versa*.

One characteristic of the disease is said to be that it affects adult males chiefly (1 in 10). Horses, cattle, pigs are also said to be susceptible to the disease. When Watt's *Commercial Products of India* was published (1908), the disease was just then very prevalent in Central Provinces and he states that the number of people more or less paralyzed was over 7,600.

Interest on the subject has been revived on account of the incidence of lathyrism in Central India during 1944-45 reported to be due to eating *khesari* (*Lathyrus sativus*) and suggestions have been made to prohibit its cultivation. It may, therefore, be well to take a retrospect of the entire situation.

Early investigations

Prior to 1923 various investigations involving chemical analysis and feeding trials with *khesari* were undertaken. The results were not concordant. This led the Indian Research Fund Association to initiate fresh investigation in which a combined study by a medical research officer, a botanist and a chemist was arranged. The clinical aspects were undertaken by Major Anderson, the botanical by Sir Albert Howard (then Mr. Howard) and the chemical by Dr Simonsen. The botanical aspects were undertaken in order that the trials might be conducted with pure grains and not with the ordinarily mixed bazar products. The results have been published in two classical papers, viz. (1) 'Studies of Lathyrism' by L. A. P. Anderson, Albert Howard and J. L. Simonsen (*Indian Journal of Medical Research*, Vol. 12, 1924, pp. 613-40), and (2) 'Indian Types of *Lathyrus sativus* L.' by Gabrielle, L. C. Howard and

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[1] *Pusa Memoirs* : Botanical Series, Vol. XV, No. 2, 1928

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K. S. Abdul Rahman Khan (*Pusa Memoirs, Botanical Series*, Vol. **15**, No. 2, 1928). It should be stated that although lathyrism had been studied possibly over 100 years (on some aspects probably still more) it goes to the credit of these investigators to plan their work in such a way that some of the hitherto unknown and even unsuspected features have been brought to light. The far-reaching significance of their work is as much of agricultural importance as of medical and others. Their work was divided into

(i) the botanical investigation of *khesari* crop and of the leguminous weeds found therein,

(ii) the chemistry of the seeds composed of the mixed crop,

(iii) feeding animals with pure cultures of *khesari* and all the weeds associated with it, and

(iv) inoculation experiments on animals with certain chemical substances which have been isolated from the seeds of one of the weeds.

In order to ensure truly representative samples on the botanical side seeds were obtained from all parts of India where lathyrism was common. These parts were Bombay, Sind, Central Provinces, Bihar, United Provinces, and the Punjab. The *Pusa Memoir* cited above gives the description of 56 elementary species obtained from these sources. It was noticed that the grain was badly contaminated by the seeds of various weeds. The point of interest here is that this extensive contamination was due on one side to 'the procumbent habit of the plant' and on the other to 'the fact that little or no cultivation is given'. Amongst the contaminated grains four leguminous weeds appear to be fairly common and one of them locally known as *Akta* (*Vicia sativia* L. Var. Angustifolia), was found in all samples in every locality in which the disease occurred.

The first condition in the investigation was, therefore, the growth in pure culture of *Lathyrus sativus* and of the various weeds met with in this crop. In this way material of known botanical composition was made available for the chemical investigation and for the feeding experiments.

Contamination with akta

It is necessary to stress here that most of the previous workers paid little or no attention to this aspect of ensuring that their investigations should be made on pure samples. This fact in all probability explains hitherto divergent results which were obtained so far. Future work also should include this important aspect. In view of the fact that *khesari* was almost invariably contaminated with *akta*, steps were taken to grow a large area with this weed. The seeds of this weed very closely resembled those of immature *khesari*. The results of chemical investigation and feeding trials with *khesari* showed that in the case of pure *khesari* the deleterious effect was entirely negative and from the chemical standpoint the seeds of *khesari* appeared to be 'harmless' and the results 'received striking confirmation when pure *khesari* was fed to ducks and monkeys'. The grains were given in very large proportion, in the case of ducks from 50 to 100 per cent and in monkeys from 70 to 100 per cent, but despite such heavy feeding the results did not indicate any deleterious effect.

In the case of weeds it was found that *akta* contained bases possessing alkaloid properties and animals fed on diets containing *akta* developed a characteristic disease syndrome showing deleterious effect on the nervous system. This suggests that while there is an undoubted connection between the consumption of *khesari* and the occurrence of lathyrism the causative factor may lie elsewhere. This also finds corroboration from another investigation conducted by S. R. A. Shah (District Medical Officer of Health, Sialkot, *Ind. Med. Gazette*, **74**, 1939, pp. 385-88) in 1935 in a village Nawankulla in Narowal Tehsil. Shah received information that the inhabitants there had been stricken with a mysterious malady which had crippled them. It should be noted here that no *khesari* is grown in this locality and from information gathered by him he found that whenever they ate wheat *chapatis* there was a set-back. On examining the wheat he found that a handful of it when placed on a dish showed 8 to 10 seeds of *akta*. The fact that the existence of the disease coincides with harvesting the wheat crop lends support to the view that the disease was associated with *akta*. It will be interesting to refer to Watt's statement already cited, viz. that the wheat-field crop was dangerous.

Turning now to the occurrence of the

disease in Central India where due to rust, blight and hailstorm (in 1944-45) wheat failed and *khesari* thrived, it was increasingly used by the poor. The crop was presumably from the wheat-field. Here it is necessary to remember the procumbent habit of the *khesari* as well as of the weed, *akta*. As a matter of fact the four weeds isolated by Howard and Abdul Rahman Khan exhibit a similar habit of growth and at the flowering stage the crop and the weeds form a dense intertwined carpet which often completely covers the ground and the tangled mass has to be uprooted in bundles as soon as the first *khesari* pods are ripe. It is obvious that under such conditions a pure culture of *khesari* must be the exception rather than the rule.

Another feature of *akta* is that the pods ripen few at a time, are explosive and scatter the seed so that any area under the weed at once becomes contaminated. Moreover the seeds are very hard and a very high proportion occurs in this crop, and a good germination is hastened after treatment with sulphuric acid. This means that under field condition all *akta* seed will not germinate in the same year but that land once contaminated with *akta* seed will go on producing an annual crop of seedlings for many years and that it will take a long time before all the dormant hard seeds germinate. It is also a hardy plant and is able to withstand the vagaries of monsoon when cultivated crops fail or grow scanty. This provides very favourable condition for a very high admixture. Naturally in years of drought and famine, the food, specially of the poor, is likely to contain a larger proportion of the weed seeds with the result that there is a larger consumption of the undesirable stuff. This might explain the incidence of the disease on an extensive scale. If this presumption is correct, its sporadic occurrence even in normal times might as well be due to the consumption of the weed along with *khesari* or other food.

Extensive researches needed

The work of the three investigators suggests that *khesari* as such is perhaps not so harmful. There are also some evidences in favour of it. For instance Stockman (*Journal of Hygiene*, Vol. **31**, 1931, p. 550) cites from Buchanan's statement 'that in some Indian jails 4 to 6 oz. per person have been given daily for years without any bad results having been observed'. As a matter of fact Stockman's investigations suggest that many of the leguminous seeds contain poisonous principles. Generally, however, the poisonous principles seem to be confined to certain specific leguminous plants and though *khesari* is undoubtedly associated with these the experiments so far conducted do not at any rate point to a direct indication that *khesari* by itself is mainly responsible for all the troubles. A recent experiment by Horvath at Pennsylvania on poultry (*Poultry Science*, 1945, Vol. **24**, pp. 291-95) showed that the feeding of *Lathyrus sativus* was followed by a substantial gain in weight and substantial increase in blood protein.

Since, however, the disease occurs under circumstances in which *khesari* forms an article of diet and since it has been amply established that *khesari* is very often contaminated with various leguminous seeds of which one, namely *akta*, contains a very dangerous proportion of the poisonous principle, it should be a matter for serious consideration whether our attention should only be concentrated on the poisonous principle or principles of *khesari*, whether, as it has been recently recommended, the consumption of *khesari* should be banned, whether such ban could be successfully carried into effect or whether we should first go into it more critically by combining the clinical and chemical investigations with those on the botanical and agronomical aspects. It is of primary importance that any experiment to be indicative of dependable result should be conducted with pure samples without any contamination whatsoever with the other seeds. Side by side research on botanical and agronomical aspects should be undertaken to see, on one side, if any strain could be evolved which would be free from the poisonous principle, if any, and to ensure, on the other, that pure samples could be obtained by adopting proper measures for the removal of the weed at the early stages. Possibly this can best be done by sowing pure *khesari* in lines a foot apart and by carefully removing the seeds of *akta* and other weeds in the earlier stages of growth.

References have been made in the earlier part that there is a suggestion for prohibiting the cultivation of *khesari*. It is however doubtful if this could be effectively done without providing a substitute in its place. As already stated *khesari* is a cheap and hardy pulse requiring very little cultivation. It will thrive on heavy clay soils and recently submerged land where no other pulse will grow. As a matter of fact there is perhaps no other pulse which can rival it in easy availability and hardiness.

There also appears on record instances of preventive measures against its cultivation. Thus Ralph Stockman (*Journal of Hygiene*, 1931, Vol. **31**, p. 554) states that in the 17th century two Dukes of Wurttemberg in succession prohibited the cultivation of *Lathyrus* in their domains, and in India and Algeria similar attempts have been made locally. But he remarks that these measures have always proved unpopular and quite ineffective. The main difficulty is that under existing conditions, the poorer people have no means of obtaining varied and better balanced deitary. The economic and agricultural background of our people is such that they have often no other alternative than to rely on this pulse for their staple food. These difficulties are indeed of a very formidable nature. From the various reports and experiments it seems that *khesari* may be operating either directly or through the creation of pre-disposing condition possibly due to the exposure to severe wet and cold and/or deficiency of some of the essential minerals, or so forth. In spite of it, force of habit and conservatism would be too strong to dissuade the people from its cultivation and/or consumption. It may, therefore, be more advisable to focus our attention to the following:

1. Provision of a suitable pulse to serve as a substitute which the people will be inclined to adopt in its place.
2. In view of the fact that previous attempt for the prevention of its cultivation has not met with success, the other alternative should be to direct the attempt towards the evolution of such strains of *khesari* which would be free from the toxic principles just as sweet lupines have been evolved in Russia in place of poisonous lupines.
3. Since the excessive feeding of the pulse seems to have been mainly responsible for the incidence of the disease we should also see if it is possible to work out some cheap dietary combination. Stockman's investigation suggests that almost all pulses contain some kinds of toxic principle and he is of opinion that in a vegetarian population in times of famine *Lathyrus* diet should not be supplemented by other pulses which according to him 'may be just as dangerous' but by cereals, fresh vegetables and fats. Unfortunately all these are costlier remedies yet some combinations drawn on similar principle can probably be the only means by which the position can be ameliorated.

Here another point also merits attention. It is well-known that in the case of fodder, *jowar*, poisonous principles are developed when they are stunted in growth either due to water scarcity or excessive rainfall. It is not known how far such a possibility is associated with *khesari* but if there is any foundation in the belief that *khesari* grown in high or low area or rice or wheat field differ in their toxic or non-toxic principles, it is necessary that investigation may also include how far there is truth in it and how a more suitable strain like sweet lupines can be evolved. This is, however, a matter in which breeding aspects are as much involved as physiological, chemical and agronomical, and all these require to be studied together simultaneously and very carefully.

NASAL SCHISTOSOMIASIS : ITS CONTROL AND TREATMENT IN WEST BENGAL

By R. N. MOHAN

LIKE other parasitic diseases, the control of nasal schistosomiasis consists of (a) treatment of affected animals and (b) prevention of infestation of healthy and treated animals. The complete eradication of the disease from affected localities calls for simultaneous action on many fronts. Unfortunately, the weapons we possess for fighting this disease are either not ideally efficient or they are such that the conditions under which they have to be employed hinder their effectiveness very greatly. It is proposed to discuss in this note some relevant aspects of the problem as it stands to-day and to suggest a feasible line of action for the control of the disease. In making these suggestions, due regard has had to be given to their actual practicability in the 'field'. Some observations concerning the incidence of the disease in West Bengal and the experience gained with regard to its treatment and control are also included.

The disease in West Bengal

'Nasal granuloma' has been known to occur in West Bengal for a long time. Unfortunately, it has not yet been possible to make a systematic survey of the disease and hence its absolute and comparative incidence in the different districts cannot be accurately assessed. There have been reports of its occurrence in almost all the districts, more often in certain areas, especially in the south-western districts (Midnapore, 24-Parganas), where the incidence is very high. Besides clinical evidence, eggs and miracidia of *Schistosoma nasalis* have been repeatedly demonstrated in material examined both locally during tours, especially by the Director and the Veterinary Investigation Officers, and in Calcutta. Nasal schistosomiasis may, therefore, be said to be widespread in West Bengal. For some time past, treatment of clinical cases of the disease has formed a part of the routine duties of the district staff. Periodical bulletins embodying information and instructions concerning the disease, its cause, life-cycle of the parasite, treatment, prevention, etc. have been sent round. A considerable amount of propaganda has also been done and matters duly explained to the cattle-owners.

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Treatment

Since about twenty years, or even more, as a result of some preliminary clinical observations made in Madras and Bihar we have known that 'nasal granuloma' is amenable to treatment with tartar emetic. Following the discovery of *Schistosoma nasalis* as the cause, some fifteen years ago, the treatment of this affection was taken up more vigorously in all the provinces in which it is prevalent. The chemotherapeutic agents employed in these provinces, and especially in West Bengal, have been (i) tartar emetic, in most cases, (ii) antimosan, in many cases, and (iii) anthiomaline, in a few cases. The experience gained in West Bengal during the last few years, which seems to be largely similar to observations reported from other provinces, is summarized and briefly discussed below.

Tartar emetic: The system of treatment generally adopted has been that found in Madras to be most successful and safe, viz. intravenous injections of weak solutions of the drug at a dose rate of (a) 1·5 grains per 100 lb. body weight daily or (b) 2·5 grains per 100 lb. body weight on alternate days, to a total of six injections. This has given the following results in West Bengal:

(1) Almost all the animals so treated have shown a varying degree of immediate abatement of the clinical affection.

(2) A large proportion of animals, when examined some months after treatment, were found still affected, even in those cases in which the complete course of injections was administered.

(3) Immediate toxic effects were manifested by a considerable proportion of animals.

(4) In very few cases, deaths have also occurred as a result of this toxic action.

(5) Inflammatory swellings in the jugular region, phlebitis and thrombosis, were not infrequent.

It may be stated here that tartar emetic has also been used in the same manner in a large number of cattle affected with Dum-Dum Sore (Stephanofilariasis) with very similar results, irrespective of whether the sodium or the potassium salt was employed.

Antimosan: This drug was found greatly superior to tartar emetic. There were no post-inoculation distrubances, the results (clinical cures) were far more complete, and relapses were rare. For reasons of cost and availability, however, the trials were limited.

Anthiomaline: Of the three drugs used, anthiomaline gave the poorest results in the few cases in which it was used.

Prevention

With our knowledge of the life-cycle and bionomics of the causative parasite becoming more or less complete some ten years ago, certain control measures have suggested themselves. They are indicated below:

(1) Prevention of contamination of drinking water with nasal discharge of affected animals by keeping them away from ponds, etc. so as to reduce the chances of the intermediate hosts (snails) becoming infested.

(2) Destruction of snails by mixing chemicals like copper sulphate in water in suitable strength, cleaning up the ponds of all vegetation, and rearing ducks, etc. in these ponds.

(3) Prevention of healthy (and treated) animals from getting infested by keeping them away from contaminated ponds and by giving them water which has been freed from cercariae by straining or by simply storing for about two days.

All these measures have been intimated to the district staff of the Department in West Bengal. They have also been repeatedly explained and recommended for adoption to the cattle-owners by means of constant propaganda. Unfortunately, the response to such propaganda in the rural areas has been practically nil.

Discussion

Tartar emetic is the only drug of some proved value which is now available for treatment of nasal schistosomiasis, but, as partly indicated above, there are certain inherent drawbacks which militate against its use on a wide scale. First of all, it cannot be said to be anywhere near being hundred per cent effective. This has been the experience in all the provinces and the West Bengal experience would indeed put its value rather low on the scale. It may be that some of the cases in which this drug failed to effect complete cure were actually cases of reinfestation, but this does not explain away the persistence of the affection in all the cases. A likely explanation may have to be sought in the incomplete or unreliable efficacy of tartar emetic and in another probable factor, which might well operate to a great extent in determining the final outcome, i.e. the use of a toxic drug in an animal which, not uncommonly in West Bengal, has little power of resistance and recovery left as a result of a chronic affliction superimposed on poor basic health. It is, however, not known what percentage of these cases were rhinosporidiosis, a disease which has been diagnosed in this province. It also seems possible that one course of treatment is not enough to kill all the parasites present so that it may be necessary to repeat the treatment after some time.

Secondly, the local inflammatory and the general toxic effects which frequently follow repeated injections of the drug, and which may occasionally be accompanied by more serious results, tend to scare away the cattle-owners.

Thirdly, the comparatively long course of injections is another deterrent.

There is, therefore, a clear case for intensive research on the chemotherapy of nasal schistosomiasis with the object of evolving a remedy which should be hundred per cent effective, simple to administer, and without the toxic and other drawbacks of tartar emetic. In the past, the question of cost seems to have greatly tipped the scales in favour of tartar emetic and has probably also been responsible for delaying research into better remedies. While cost as a factor cannot be completely ignored, it should not be allowed to interfere unduly.

With regard to the preventive measures, it seems hardly necessary to embark on a detailed discussion of their merits and demerits. The conditions prevailing in rural areas all over the country are too well-known to 'field' workers to justify elaborate consideration of the feasibility of such measures. This aspect of the problem is closely linked with the problem of rural uplift and pending the general education and enlightenment of the cattle-owners themselves, and particularly the vast improvement required in rural conditions in general, we should not hope to accomplish much in this direction. No amount of propaganda is going to bring about a successful achievement of the ideal objective and enforced legislation will only make matters worse. The few stray attempts made in West Bengal and elsewhere with a view to inducing cattle-owners to put into practice one or more of the necessary preventive measures have not been rewarded with substantial success. There is, however, no reason why we should not continue our efforts, and even increase them. After all whatever little we can achieve may prove worth the trouble. What seems more promising in this respect is the establishment of actual demonstration centres in the form of small units of animals subjected to regular treatment and control in otherwise untreated villages as well as whole villages subjected to such treatment and control in untreated neighbourhood.

Recommendations

In the foregoing discussion it has been stressed that (1) the only remedy now available for treating nasal schistosomiasis, viz. tartar emetic, falls much below the ideal and (2) the preventive measures, in view of the conditions under which they have generally to be applied, cannot be expected to give efficient results. The following steps are, therefore, suggested for future work.

Routine treatment and control :

(1) Pending discovery of a better remedy, treatment with tartar emetic may be continued as before. The objective should be to detect all affected cases, preferably by microscopical examination of nasal discharge of all animals, and to treat them at least twice a year. This may necessitate employment of extra staff working under the direct supervision of a specially trained officer. The proposed post-war development plans of the provinces should cover this need to a great extent. It may be necessary to enforce treatment by legislation and to provide compensation in case of accidents.

(2) Propaganda work should be continued more vigorously than in the past and cattle-owners should, as far as possible, be induced to apply the simple measures for avoiding or destroying the developmental stages of the parasite.

(3) In badly affected localities, the Government should supplement the necessary labour and expense for such measures as filling up of surplus ponds and fencing off most of the ponds, leaving only a few for animals which may periodically be cleaned up and treated with copper sulphate.

(4) It may be of advantage to set up a few demonstration centres as outlined in the note.

(5) The Provincial Departments should keep accurate records of all work undertaken in this connection.

Research :

(1) Work should be taken up immediately to find out an ideal remedy for treatment of affected animals. This may be done at (a) the Indian Veterinary Research Institute, and (b) some selected centres in the 'field'.

(2) Work should be taken up in the provinces to improve our knowledge of certain important aspects of the subject. Some of the questions that call for reliable answers are :

(i) Can better results be expected by repeating the course of treatment ? If so, what should be the optimum interval ?

(ii) How long after infestation does an animal start excreting eggs in its nasal discharge ?

(iii) How long after infestation does a snail continue to discharge cercariae ?

(iv) What is the usual length of the life-cycle of the parasite from egg to cercariae ?

(v) What is the optimum strength of copper sulphate solution required to kill all snails and how often will it have to be used ?

(vi) What local factors determine the endemicity of the disease in certain localities ?

(vii) Are there any seasonal fluctuations in the incidence ? If so, what environmental factors govern these ?

Acknowledgment

The paper includes the experience of Mr. S. M. Ali, formerly Director of Veterinary Services, Bengal.

CONTROL OF POULTRY MORTALITY IN INDIA

By S. G. IYER

NOTWITHSTANDING the fact that the prices of eggs and poultry have been greatly increased in recent years, expansion of the industry on modern lines is being retarded by fear of disease epidemics which often carry off large numbers of stocks. Compared with Western countries, the Indian methods of production are very primitive and the poultry industry in this country is still in a backward state. The low average egg production and high mortality figures are largely due to errors in housing, feeding and management. It is difficult to get accurate data of the actual losses suffered under village conditions of poultry-keeping, but from the limited data available it is evident that losses from contagious diseases are frequently very high in specialized farms. Under village conditions losses in rearing from 0-6 months are estimated to be around 40 to 50 per cent. From a three years' disease survey carried out by the author, it has been found that in the order of importance the more common diseases decimating the poultry population are : Ranikhet (or Newcastle disease), fowl pox, tick fever and coccidiosis of chickens.

Ranikhet disease

Ranikhet disease has in recent years received more prominence than any other poultry disease. Its incidence is higher in areas where there is a greater movement of stock which is conducive to the spread of infection. Outbreaks of the disease have been reported during all parts of the year. It is mainly confined to fowls, while ducks and geese are immune. In diagnosing this disease care should be taken to eliminate possibilities of death from other conditions such as fowl cholera and tick fever. Medicinal treatment of affected birds is valueless and a questionable procedure owing to the rapidity with which the disease spreads. As the result of intensive research work at the Indian Veterinary Research Institute, Mukteswar, a successful method of vaccination has been evolved and it is now possible to have the stock permanently immunized against this disease. The vaccine is prepared by attenuating live virus on developing chick embryos. One of the main difficulties involved in the field use of the vaccine is its perishable nature at ordinary atmospheric temperatures. In order to overcome this difficulty storage depots are being established in different parts of the country. Vaccination produces solid immunity within three days. Inoculation of the vaccine may result in a loss of some 2 to 3 per cent through birds becoming lame but poultry-keepers should cheerfully face this loss as an insurance against further loss. Once the disease becomes generalized throughout a farm, inoculation of stock will have only limited value.

Ranikhet disease is largely spread through the purchase of birds in the incubative stages and the poultry markets are a hot-bed of infection. Many producers, as soon as the first sign of disease is noticed, rush their stock to the markets. In order to prevent introduction of disease all new stock should be quarantined for at least ten days on arrival.

Fowl pox

Fowl pox is very common from October to March throughout the country. In adult birds the mortality is not great but the infection, whether mild or severe, upsets egg production. In chickens, however, the mortality may exceed 50 per cent and usually the eyes and mouth are affected, while in the adult stock the skin lesions are more often noticed with or without involvement of the eyes or mouth. *Desi* birds seem to be more susceptible than imported breeds. Reports have also been received of high losses among turkeys, but the type of virus causing the disease in turkeys is perhaps different from that of fowl pox.

Severely affected birds should be destroyed without delay and the mild cases placed under quarantine until recovery takes place. Infected houses and all equipment with which the

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birds come in contact should be thoroughly disinfected prior to being used by other birds.

Fowl pox can normally be prevented by vaccination. In India, the vaccine is made from pigeon and fowl pox viruses. This vaccine gives protection for a considerable period. On commercial farms vaccination at eight weeks and at 24 weeks is recommended as a fairly safe method of control. Experiments on the use of vaccine in chickens have revealed that vaccination below six weeks of age is valueless. The duration of immunity has still to be finally established. The vaccine is liable to lose its potency when stored under the high temperatures prevailing during summer months and the despatch and storage of the dry vaccine are becoming popular.

Tick fever

Tick fever is a popular name for Spirochaetosis. It is another disease which causes heavy losses amongst all classes of stock. It is spread by the tick *Argas persicus.* The adult stock is often unnoticed because it attacks birds at night only, but the seed ticks which are very small may remain on the bird's body for a week or so. The presence of tick fever is recognized by demonstration of spirochaetes in blood films of the affected birds during the height of fever.

Birds suffering from tick fever can be cured by an intra-muscular injection of 3 to 5 c.c. of one per cent solution of sulpharsenol, but early treatment is most essential for success. Flocks can be protected from tick fever by injecting blood containing spirochaetes and 48 hours later giving a curative dose of sulpharsenol. Treatment of affected birds or protective inoculations will not put an end to the trouble for the ticks also cause much damage through irritation and loss of blood. Destruction of ticks is by no means easy as they live in cracks and crevices for years without food. *Katcha* houses should be avoided as far as possible. In permanent buildings periodic treatments with blow lamp or painting of the perches and nests with kerosene will eradicate the ticks. Seed ticks infesting birds can be destroyed by swabbing them only on affected areas of the body with a 10 per cent suspension of derris root powder in water or by D.D.T. spray. While constructing poultry-houses tick-proof perches should be provided as a routine. The perch should be fixed on upright iron rods driven into the ground about two feet. To the top of the iron rod and about 4 in. below the perch small iron cups should be soldered which should always be filled with kerosene oil.

Birds frequently get infested with ticks during railway journeys and, therefore, it is a sound policy to isolate new birds on arrival in coops for at least nine days. After this period the fresh stock may be run with other birds as any seed ticks which might have been picked up *en route* will have left the birds.

Coccidiosis

Practically no information is available in regard to losses from coccidiosis under village conditions of rearing while under specialized conditions coccidiosis (caecal) is a major cause of mortality in chicks up to ten weeks of age. In adult birds the doudenal type is met with but to a less extent. In the chicks the incidence is more in wet weather which is favourable for the development of the parasite outside the body of the bird. The disease can usually be controlled by daily cleaning of the litter and all equipment with which the chicks come in contact. Daily cleaning removes the eggs of coccidia voided in the droppings which are harmless to the stock when picked up within one or two days of being excreted. Recent studies made at the Indian Veterinary Research Institute suggest that good results can be obtained by treatment with preparations such as Sulphamezathine or Sulphathiazole.

Birds can also be immunized against the different species of the parasite, but it has only limited value for field control. Beyond ten weeks of age chicks are seldom attacked by the caecal type coccidiosis for a natural resistance develops with advancing age.

Chicks of different ages should not be reared together and on no account chicks should be allowed to run with fowls which had an attack of coccidiosis. At the commencement of an attack the poultry-keeper should not grudge to kill off all weak and diseased birds. Though some of the affected chickens may recover they may act as carriers capable of reinfesting later hatches of chicks.

Non-specific causes

The poultry-keeper has also to contend with losses due to mismanagement or mal-nutrition.

Errors in breeding, such as paying less attention to constitutional vigour, have been a very important contributory factor. Undue emphasis should not be laid to egg production alone in the selection of breeders particularly in specialized farms. One of the primary causes of high mortality in very young chickens is poor nutrition and the period from 0-8 weeks is most critical in the life of the bird and the losses can be considerably reduced by feeding better balanced foods during this period such as butter-milk, separated milk, meat offal, fish meal, etc. supplemented with available greens and calcium in one form or the other. Losses in villages are also very high on account of inadequate nutrition. As the food required per chicken from 0-8 weeks is only about four pounds any extra cost of feeding will be well repaid by increased growth-rate and reduced mortality.

Wild animals and birds are the natural enemies of the chicken and take away young stocks. Confinement during the early stages of growth would prevent such losses. Under artificial conditions of rearing, overcrowding which is frequently responsible for poor growth-rate and incidence of disease should be avoided.

DECLINE IN RICE PRODUCTION IN ASIA

POPULATION increase in South and East Asia continues to outstrip increase in the production of rice—basic food for nearly half the world's population—the Food and Agriculture Organization reported on June 27 in a special rice bulletin.

Despite shortages of machinery and equipment, production plans for the next three years envisage expanding the rice area in Asia and elsewhere to raise the total area by 2,500,000 hectares above pre-war. But taking account the desirable level of nutrition for the increased population, the production goals indicate a deficit of more than 14,000,000 metric tons in each of the next two years and of more than 13,000,000 tons in 1950.

Even allowing for the fact that estimates of rice consumption are in many cases merely approximations, the bulletin pointed out that deficits of such magnitude should serve as a warning that the present plans envisaged cannot safely be considered as meeting the future needs of the rice-eating population.—*Food Bulletin*, July 5, 1948.

What the Scientists are doing

1948 BATCH OF NEW CO. CANES

THE 1948 batch of Co. canes consists of 30 new varieties, viz. Co. 660 to Co. 689 (both inclusive). From this year it has been decided to release the above large number of new canes with a view to giving the provincial stations greater choice for selection. The selection at Coimbatore has been none too rigid but an attempt has been made to cover a wide range of types, including one cane of likely use as chewing cane, viz. Co. 677. The parentages and general characteristics of these canes are given below. As regards the parentage of Co. 664 and Co. 665 it has to be mentioned that since parthenogenetic seed formation is common in intergeneric crosses the parentage of these two seedling varieties should be regarded as tentative.

It has to be added for the information of the sugarcane growers that these canes have been released, in the first instance, for trials at the respective Provincial Sugarcane Stations and that it usually takes at least three to four years for such of these canes as successfully pass out of the trials before they become available for distribution for general cultivation.

Further information about the suitability or otherwise of these canes to particular tracts or localities will be available from the respective Provincial Sugarcane Specialists after the promising ones out of these Co. canes have been tested in the zonal trials.

S. No.	Co. No.	Parentage	General characteristics
1.	Co. 660	Co. 213×P.O.J. 2878	Co. 331 type but sparser in flowering. Mid-season. (18·65)*
2.	Co. 661	Co. 213×(Co. 385×Co: 301)	Co. 331 type. Late. (16·01)
3.	Co. 662	Co. 349×Co. 301	Co. 419 type but sparser in flowering and not so tall. Mid-season. (17·31)
4.	Co. 663	—Do.—	Co. 421 type. Sparser in flowering and not top heavy. Easy of trashing. Mid-season (16·43)
5.	Co. 664	Co. 349×African *Sorghum* (A.S. 4601)	P.O.J. 2878 type but with harder rind. Mid-season. (19·33)
6.	Co. 665	Co. 349×African *Sorghum* (A.S. 4653)	Co. 349 type. Moderate in height and not likely to lodge. Early. (18·64)
7.	Co. 666	Co. 351×Co. 545	*Sorghum* is one of its grand parents. Early. (19·31)
8.	Co. 667	—Do.—	Same parentage as above but only a mid-season cane. (17·93)
9.	Co. 668	Co. 357×Co. 545	*Sorghum* is one of its grand parents. An early cane with good purity and fair yield. (17·58)
10.	Co. 669	Co. 443×Purple Mauritius	A thickish cane of medium height. Mid-season. (17·81)
11.	Co. 670	Co. 508×Co. 301	Co. 508 type. Early. (18·88)

* Figures in brackets refer to sucrose per cent in juice.

S. No.	Co. No.	Parentage	General characteristics
12.	Co. 671	Co. 508×Co. 395	Co. 395 type. Borer attack very moderate. Mid-season. (17·19)
13.	Co. 672	Co. 508×Co. 453	Co. 453 type. Heavy yielder. Late. (16·91)
14.	Co. 673	Co. 508×Co. 545	Co. 421 type but slightly thinner. Vigorous in growth. Mid-season. (17·36)
15.	Co. 674	Co. 508×(Co. 349×*Uba Marot*)	Co. 213 type but with better sugar. *Uba Marot* is one of its grand parents. Mid-season. (18·65)
16.	Co. 675	Co. 524×Co. 301	Co. 419 type, late. (17·30)
17.	Co. 676	Co. 527×Co. 508	A mid-season cane of good habit. (16·70)
18.	Co. 677	Co. 603×Co. 301	Co. 603 type but heavier yielder. Of likely use as a chewing cane. Early. (19·63)
19.	Co. 678	—Do.—	Co. 603 type. Heavier yielder. Late. (16·39)
20.	Co. 679	Co. 616×(Co. 285×Co. 440)	Co. 419 type. A mid-season cane of fair sucrose. (19·73)
21.	Co. 680	Co. 625×Co. 605	Co. 421 type. Late. (15·42)
22.	Co. 681	P.O.J. 2878×Co. 301	A mid-season cane approaching Co. 421 type. (16·13)
23.	Co. 682	P.O.J. 2878×Co. 453	Co. 421 type. Early ripener of good yield. (21·04)
24.	Co. 683	P.O.J. 2878×B. 3412	Co. 421 type but heavy yielder. Same parentage as Co. 421. Tall growing but not likely to snap. Mid-season. (18·08)
25.	Co. 684	P.O.J. 2878×(Fiji B., G.C.)	Co. 419 type, late. (15·63)
26.	Co. 685	(Co. 331×S.W. 111)×(Co. 285×Co. 440)	Co. 421 type. A heavy yielding late cane. (13·06)
27.	Co. 686	(Co. 421×Co. 440)×Co. 281	Co. 313 type. Early ripener of good yield. (19·58)
28.	Co. 687	(Co. 421×Co. 440)×Co. 419	Co. 419 type. Heavy yielding late cane. (13·24)
29.	Co. 688	Fiji B., G.C.×Co. 475	Co. 419 type. Early cane of good sugar. (21·04)
30.	Co. 689	Fiji B., G.C.×(Co. 419×B. 3412)	Co. 419 type. Tall growing but not likely to snap. Mid-season. (18·05)

(Sugarcane Breeding Station, Coimbatore).

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Divergent opinions have been expressed regarding the use of fertilizers under Indian conditions. Will you please indicate the considered opinion of your Department on the subject ?

A. This Department has always stressed and continues to stress the need for securing that as much heavy organic manures, such as cow-dung, town-refuse composts and composts made from vegetables and village wastes, as possible should be returned to the soil to meet the basic humus requirements of the land. Under tropical conditions humus gets burnt out quickly and unless it is replaced in some form or another, fertility and water holding capacity of the soil are likely to suffer. It is for this reason that this Department has sponsored the largescale production of composts from both town-refuse and night-soil and village wastes and vegetable matter. The production of organic manure in adequate quantities to meet the full nutritive requirements of crops and soils is however not a practical proposition and should be supplemented by other forms of manures for supplying the base plant foods so essential for increasing agricultural production in general and the production of food crops in particular. Hence the need for increasing the use of fertilizers whether they are in the form of oilcakes, or sulphate of ammonia or bonemeal.

Under Indian conditions there are no scientific data tending to show that the continued rational use (the emphasis being on the word rational) of fertilizers has an adverse effect on the soils on which it is used or on the crops that are produced therefrom. At the same time there are also no data to prove the contrary. Evidence, however, is available on the continued use of chemicals for over a hundred years on some of the experimental plots at Rothamsted (England) where such use has shown no deleterious effect and where crop yields have shown a continuous and steady increase. Under Indian conditions, the recommendation of this Department has always been to use as much heavy organic manure as possible as a basic dressing and to supplement it with preferably a mixture of concentrated organic manures and the chemical fertilizers in order to provide sufficient plant nutrients for the production of a reasonably good crop under any given set of conditions. The kind of mixtures to be used will depend upon the nature of the soil and the climatic conditions of each area. The Chemist of the Provincial Government should be able to determine the suitable mixture. In order to forestall any possible damage that may be feared as a result of the long range use of chemical fertilizers, particularly of sulphate of ammonia which is acidic in reaction, the obvious thing to do is to use lime in some form or another at specified intervals. The best form in the view of this Department would be bonemeal which not only actually supplies large quantities of lime but also substantial quantities of phosphates and some quantities of nitrogen. Failing this, ordinary lime could be used. Under neutral or alkaline conditions, an application of one-third of a ton of lime per acre once every five or seven years should be ample, while on acidic soils the use of bonemeal every year in suitable quantities would definitely preclude any possibility of harm.

As regards the economics of manuring, this Department is of the opinion that while the use of manures and fertilizers does give increased yield, the value of such yield is not likely to recompense the cultivators sufficiently for the increased expenditure and enterprise involved in the use of fertilizers on a large enough scale unless the prices of fertilizers bore a definite relation to the prices of food crops. This relation has been in the past generally unfavourable and still remains so. It will continue to be unfavourable until the production and use of fertilizers are developed on a sufficiently large scale to enable the prices of fertilizers being brought down not only absolutely, but relatively to the prices of food crops. In the meanwhile there is need for making available both composts and concentrated manures on a subsidized basis, as has been stressed by this Department more than once, in order to foster their development and to increase the production of food.

The controversy on the use of heavy organic manures *versus* concentrated fertilizers was raised at the last Food and Agricultural Organization Committee meetings, and at the Food and Agricultural Organization Conference held at Copenhagen in September 1946. It is understood that this world authority came to the considered conclusion that apart from water the rational use of fertilizers is the only method known to the scientific world whereby increased production can be assured quickly. In consultation with nutrition experts it was further stated that there is no evidence to show that the rational use of such manures does harm either to man, beast or soil. A very interesting article on this subject was published in the *Scottish Journal of Agriculture* in its issue of January, 1945 by Dr Ogg, Director of Rothamsted Experimental Station and Dr Nicol of the Imperial Bureau of Science.—*Ministry of Agriculture.*

yeddondhû ghaligelî yaryarâ neneyalî, yellû jeerigê beliyolâ—
yellû jeeregê beleyô bhomitayiyâ, yeddondhû ghaligelî nenedenô.

As I rise in the morning my remembrance runs to many a deity. First let me thank her that grows the sesame and *jira.* Mother Earth that grows the sesame and the *jira.* My prayer to her as I rise in the morning hour.—*Agricultural aphorism from Mysore.*

MYSORE

M. L. N. IYENGAR

THE following schemes for the development of agriculture in Mysore have been either sanctioned or are under the active consideration of the Government.

Expansion of the extension staff

The Mysore Department of Agriculture was reorganized on its present lines in 1915. Consequent on the increasing tempo of agricultural development in the war and post-war years, the Government have recently sanctioned reorganization of the extension arm of the Department. There is now an Agricultural Inspector for each taluk (and there are 84 taluks with an average area of about 350 sq. miles) and in a couple of years there will be an Agricultural Fieldman in each of the 362 *hoblis*[1]. The ryots in the interior parts are served by nearly 200 agricultural depots carrying stocks of all agricultural requisites. To relieve the extension staff of heavy sales work in the depots and divert their energies towards their legitimate work of propaganda and demonstration, adequate ministerial staff has also been provided. To improve the content and scope of extension work, proposals are being worked out to reorganize agricultural propaganda. It is learnt that a propaganda van equipped with projectors, etc. will shortly be bought. It is also proposed to form a film unit for preparation of instructional 'shorts'.

Agricultural education

An Agricultural College affiliated to the Mysore University has recently been started at Hebbal where the premier Agricultural School, established in 1915, is also situated. It is learnt that an Agricultural Research Institute will also be established there. All the personnel required during the coming years will be recruited from these institutions.

There are four Kannada agricultural schools. Two more will be shortly opened in the *malnad*[2]. Some necessary changes with a view to make them more effective and attractive were carried out.

Visual education of farmers

Mention has been made of the plans for reorganization of agricultural propaganda. One such scheme was inaugurated in November 1947. Every year some 350 farmers, one from each *hobli*, will be taken round the main agricultural stations of the State at Government cost and brought into contact with the work of the Department. The first batch of more than 300 ryots met at the Irwin Canal Farm, Mandya (the largest irrigated farm in South India with an area of 600 acres). All their travelling and boarding expenses were met by the Government. In the evenings lectures, magic lantern slides and film shows were arranged. Demonstrations in tractor-ploughing, compost-making, *gur* and sugar-making, etc. were also held. On the final day they all went into a sort of a ryots' conference which was presided over by the Minister of Agriculture, Mr. H. Siddayya, and evoked unprecedented enthusiasm. There were free discussions of agricultural problems and methods and it looked as though the ryots had at last found their voice. Altogether the visual education scheme was a roaring success and is full of potentialities for the future of Mysore agriculture.

M. L. N. IYENGAR, B.A., L.AG., B.T., is Technical Assistant to the Director of Agriculture, Mysore.

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[1] *Hobli*: A taluk sub-unit comprising of a group of villages.

[2] *Malnad*: The State is broadly divided into two climatic zones. The *malnad* is the region of hills and heavy rainfall; and the *maidan* is plain country with low rainfall.

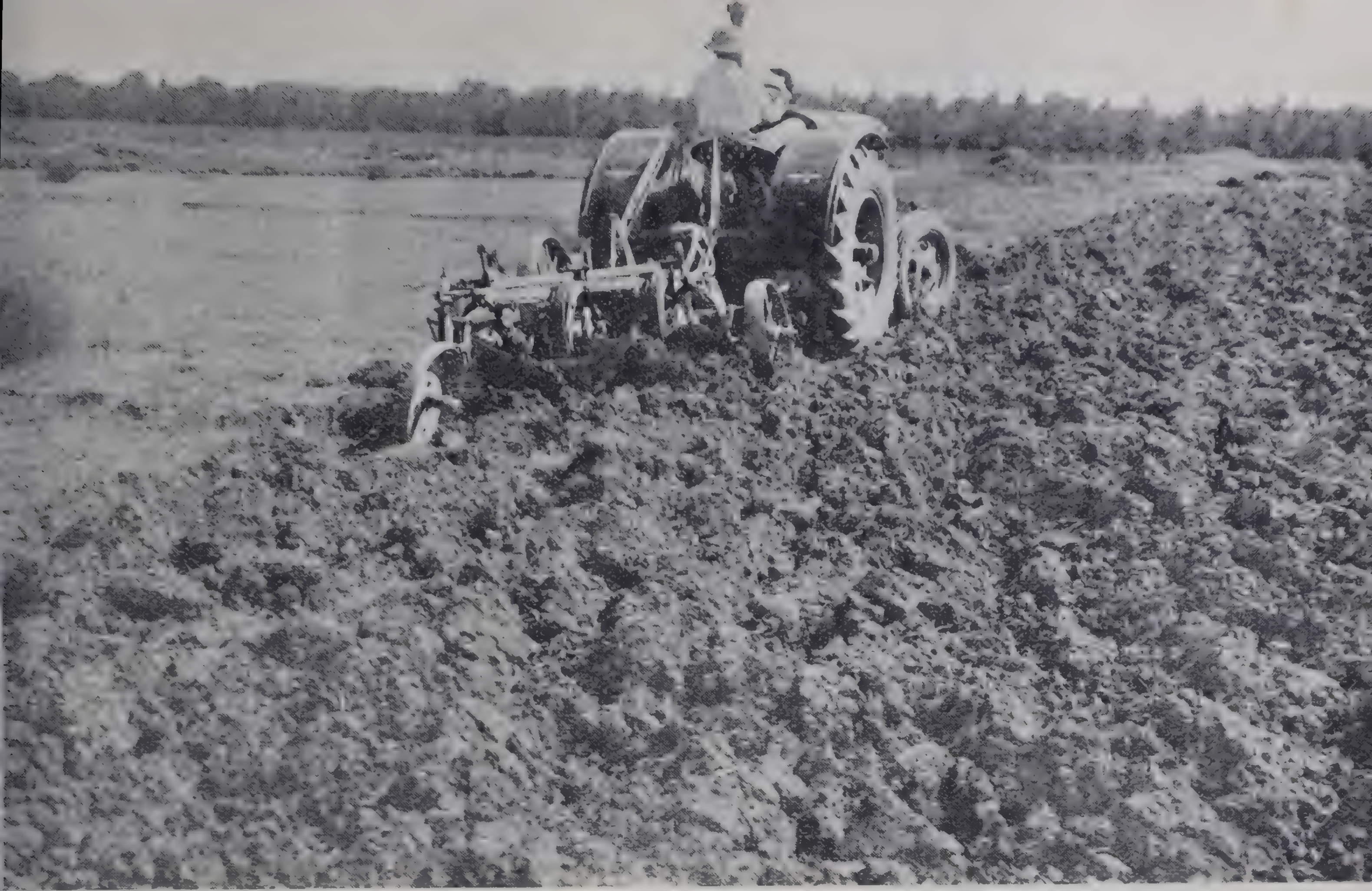

FIG. 1. (above). Tractor-ploughing at Irwin Canal Farm, Mandya.

FIG. 2. (below). The Minister for Agriculture, Mr. H. Siddayya, being welcomed by Mr. K. H. Srinivasan, Director of Agriculture, and other representatives at Irwin Canal Farm before the Ryots' meeting held on 29 November 1947.

Regional and demonstration farms

In addition to the major and minor agricultural farms in the State, eight in number, including the Coffee Research Station, five more farms will be opened shortly. These farms will conduct investigations on agronomy and crops peculiar to each crop region in the State. The necessary personnel is being trained. Ten demonstration farms in important taluk headquarters will also be shortly established and another 40 will be opened at the rate of five each year—the idea being to make them centres of agricultural development and progress for each taluk. These with the thousands of demonstration plots, subvention farms and 'A' farms on ryots' holdings and backed up by an intensive barrage of activity from the extension arm and the propaganda section, may certainly usher in a new era of agricultural development.

Reorganization of statistical section

The Department of Agriculture in the State was one of the earliest to organize a statistical branch and adopt modern statistical methods in the design and conduct of field experiments. An officer has been deputed to undergo higher training in this subject in the United States of America. In the meantime the section is being reorganized and strengthened. Agricultural meteorology will also come under its purview.

Biological control of insect pests

With the experience gained at the Parasite Laboratory in Mandya (the centre of sugar industry) started as early as 1935 for the control of sugarcane borer, the Department is shortly launching a scheme for the investigation of the possibilities of biological control of other major crop pests in the State. Preliminary investigations with the larval parasites of *Corcyra cephalonica*, *Epilachna*-28 *punctata* and *Bruchus chinensis*, have suggested some new promising lines of enquiry.

COCHIN

C. S. VENKITASUBBAN

THE food problem in the State is daily becoming a matter of concern. It has been rendered very difficult as much by the conditions arising after the War, as those created by nature. Agricultural production is now beset with severe handicaps, and the farmer sticks to his job, because he has no other alternative. In the first place, agricultural labour has become very costly. The labourer is more alive to his demands than his obligations as a producer. He has to be coaxed even to carry out his work. Secondly, manures have become scarce and prohibitive in cost. The chief sources of supply of groundnut cake, Hyderabad and the Kathiawad States, have turned out to be very uncertain sources now. Whatever is procurable entails heavy costs and the cultivators cannot afford to purchase them without a generous amount of subsidy. Lastly, nature too has turned to be very unkind. The majority of the crops in the State depend mainly on rainfall and irrigation facilities are limited. If the rains disappoint, crop failures cannot be averted. The south-west monsoon of 1947 started late, the precipitations were uncertain and uneven. The first crop of paddy, *virippu,* suffered from dearth of water in its early and middle stages, from June to the middle of August 1947. The growth of the plants and production of ear-heads were very defective. But disappointment was extreme, when even this small crop could not materialize owing to sudden and heavy outbursts of rain when the ear-heads were maturing. Most of the standing crop was either submerged or drenched. The rains continued from the middle of August to about the end of September 1947, rendering the operations of harvest, threshing, etc. very difficult. The women who usually do the harvesting of paddy were not forthcoming unless they were paid definite wages in kind,

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instead of the customary proportion of paddy harvested and threshed. In normal times the cultivator would have preferred to let his crop go waste unharvested rather than pay such unreasonable wages. The yield of the *virippu* crop throughout the State was very low, while the production of straw was still lower.

Excepting a few isolated showers a month later than the usual period, the north-east monsoon also was a complete failure, as far as the State was concerned. The second crop, *mundakan*, which followed the *virippu* rather late, was also subjected to drought. In many places, the crop had entirely dried out. Whatever was obtained was only a tithe of what is produced in normal years. The State which in normal times produces only about half her requirements of paddy may be said to have produced less than a fourth of her requirements in the last two principal paddy seasons. Within living memory no such scarcity has been experienced by her till now. The question of imports from outside is also a vexed problem. The State has been advised to survive on coconuts and fish if she is unable to grow or procure other foodstuffs.

Increased production of foodstuffs

Extension of the paddy area to its practical limits has already been carried out. Deforestation of marginal areas and the cultivation of 'hill paddy' are being done wherever possible. The Government has continued, in a greater measure, all the inducements initiated in previous years to increase production. A provision of Rs. 6,25,000 has been made to purchase manures and sell them to ryots at subsidized rates. A sum of Rs. 20,000 has been sanctioned in the first instance to take up a scheme designed to bring one lakh of acre under improved strains within a period of five years.

During the months of November and December 1947, every available engine and pump in the State was requisitioned by the Government and utilized to pump water from all existing reservoirs. About a dozen engines and pumps were also specially purchased for this purpose. Every bit of available water was used to save as much of the second crop as possible. The pumping works were carried out entirely at Government expense and the cultivators were supplied with water free of all obligations.

Two major schemes of irrigation have been taken up and works are progressing steadily.

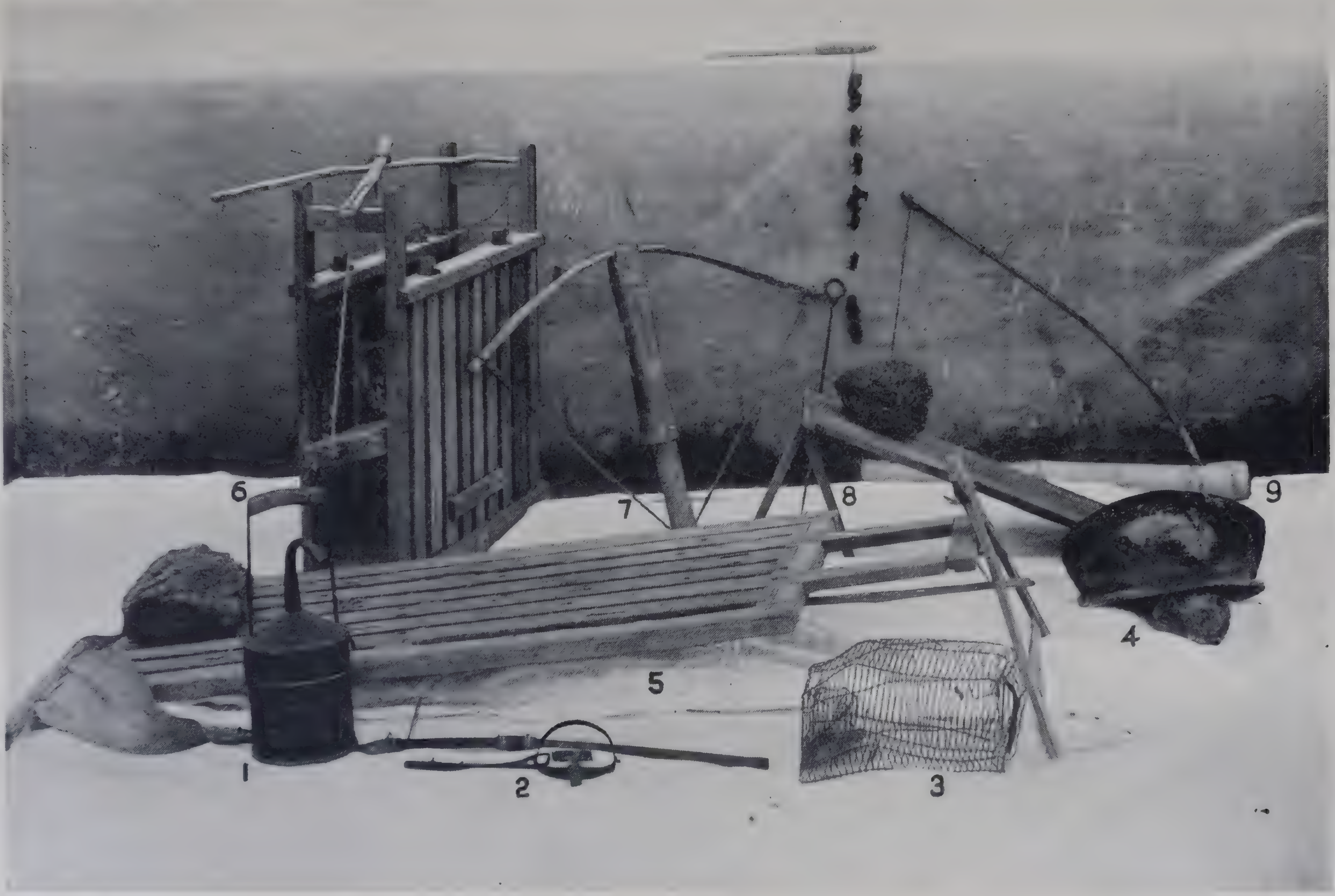
Notwithstanding all these efforts, the total production of paddy will not suffice to feed the population all through the year. Other food crops require to be cultivated more extensively to offset the shortage of paddy and the Agricultural Department is bestowing systematic attention to them.

Cereal metality

There is a general idea that paddy is the main food and that other cereals, tubers, etc. can only be supplementary foods. The term 'famine food' as applied to tapioca makes this idea very clear. The public in Cochin revert to tapioca and other cereals only when paddy is unprocurable, and when sufficient paddy becomes available, the other foods are relegated to the background, if not discarded altogether. The taste for paddy is deeply inherent and the people cannot be easily shaken out of it.

But instead of turning to tapioca whenever there are shortages of paddy, if the people had utilized tapioca and other carbohydrates in their daily diet, then the food problem would have been solved to a considerable extent. Propaganda in this direction is now actively carried out; people are being taught that paddy is eaten mainly for its carbohydrate contents and that this carbohydrate can be equally derived from tubers and other materials. There is now an increasing number of people who utilize tapioca as a daily item of food, but this number will fall down if the position of rice improves. The aim of the propaganda is to make the use of tapioca regular and universal. Trials are conducted by some private agencies to produce tapioca starch grains of the shape of rice grains.

The production and consumption of vegetable products have risen as a matter of urgent necessity. The public have been carrying on for a long time without sufficient supplies of milk and pulses, and there is increasing realization that fruit and vegetable can replace the former materials to a large extent. A sum of Rs. 7,500 has been provided in the current year for the provision of vegetable seeds to growers at subsidized rates.



Rodent traps in local use in Cochin:
(1) Fumigator (2) Spring trap (3) Wire-net cage trap (4) Mud pot trap (5) Dead-weight fall trap (6) Another form of dead-weight fall trap (7) Bamboo piston strike trap (8) Figure of four trap (9) Bamboo noose trap.

PLATE 23

Manure problem

The production of tapioca and plantains which are encouraged to be cultivated extensively requires larger quantities of manure. The manurial resources of the State are being husbanded systematically. Green manuring is not generally practised in Cochin as the off-season when the land lies idle is very short and unfavourable to the growth of crops. But green-manure plants are grown extensively as cover and inter-crops in estates and gardens. A sum of Rs. 500 has been provided this year to conduct trials to find out how far growing of green-manure crops *in situ* will be successful.

Work has already been commenced to open compost pits for demonstration. The aim is to provide at least one pit in each of the eighty-seven *panchayats* in the State. The work of utilization of wastes has been taken up as a regular feature of departmental activity. Composts manufactured by the premier municipalities in the State are finding an easy way to the cultivator's fields now.

Rodent control

The rodents have become serious pests of every kind of crop now. The Department is waging regular campaigns against these depredators through village organizations. Trapping, baiting, and fumigation are being conducted regularly. The Agricultural Department have constructed five hundred traps and one hundred fumigators for use in these campaigns. For baiting, fish is found to be very attractive and is now being used very successfully. Local forms of trapping are also encouraged.

HORMONE SPRAYS STILL BEING TRIED

USE of hormone sprays to prevent fruit drop in orchards, is still in the experimental stage in Australia, but encouraging results have been obtained.

New South Wales Department of Agriculture now advised orchardists that there is no doubt of the effectiveness of these sprays when suitably used, but that results depend entirely on the thoroughness of the application. Under practical orchard conditions this means spraying the whole tree, which materially affects the cost of the operation, and may restrict the use of spraying to varieties of trees especially susceptible to fruit drop.—*Agricultural Newsletter*, No. AGN/198.

Across the Borders

THE ROLE OF VETERINARY MEDICINE IN PUBLIC HEALTH[*]

By Wm. F. LAMB

IT is indeed a pleasure to have the opportunity of addressing the Southern Veterinary Association as fellow practitioners of the healing art, whether it be man or animal.

In this rapidly changing era, marked by kaleidoscopic developments of newer methods of warfare, housing, manufacture, and feeding, medical men of all branches of the profession are faced with a challenge heretofore unknown. Through scientific improvement of the airplane, travel to all parts of the world is possible in a matter of hours, and it naturally follows that we face not only diseases common to United States but those existing in South America, the South Pacific, and the Orient as well. Increasing vigilance is necessary to prevent their introduction and spread in this country.

Essentials of good public health

As a result, we of the medical profession are cognizant of the serious implications which may arise and, in our determination to prevent and control the spread of communicable diseases, both among men and animals, we have welded ourselves into one body. No longer are we medical men, or veterinarians, but doctors, dedicated to one purpose—a never-ending fight against disease, whether local or foreign in origin, for we are now truly one people and one world. Man's interest in animal diseases cannot be confined to those which are directly transmissible to him, for today's conception of good public health goes far beyond mere freedom from communicable diseases on the part of man. The crying need for meat to feed the world, for milk and other dairy products, makes the medical profession more and more aware of this. The affection of the boy for his dog, the man for his race horse, and the farmer for his herd of cattle is an intangible concept which reaches to the veritable core of our everyday life, for good public health not only embraces freedom from diseases, adequate food and housing, but also happiness brought about through relationship with animals.

Progress of veterinary medicine

Through the application of modern methods of prevention and treatment, such diseases as smallpox, diphtheria, scarlet fever, typhoid, cholera, plague, and yellow fever have virtually been eliminated in many sections of the world. With recently acquired knowledge and the application of measures for the eradication of disease, communicable disease control both in man and animal marches along and shows signs of being maintained at a high level of efficiency. It is of tremendous importance to keep in mind the diseases of animals transmissible to man, human diseases spread by animals or animal products, and the animals which act as passive carriers of disease organisms.

If we had time to trace the progress of veterinary and human medicine, we would see that they have advanced through similar stages, and in various places we would find one helping the other. Development of the science of veterinary medicine had for its original purpose the relief of suffering and the restoration to health of horses, chiefly those

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[*] Address of welcome by Dr Wm. F. Lamb at the joint meeting of the Southern Veterinary Medical Association and the Kentucky Veterinary Medical Association in Louisville, September 30 to October 2, 1946.

DR LAMB is Director of Communicable Disease Control, Louisville and Jefferson County Board of Health, and Assistant Professor Preventive Medicine, Louisville School of Medicine.

used in the armies of that day. However the science has developed through the years to have as its general objective the relief of suffering and the prevention of disease in all animals, not only those which have great economic value, but also pet animals, which have great sentimental value to man.

Modern veterinary medicine, however, goes far beyond this. In recent years, it has come to be regarded as indispensable to the prevention of infectious diseases in man—an important part of a public health programme. Many diseases occurring in man have been found to be natural diseases of lower animals that are transmitted to man through contact, through environment, or through the channels of animal foods.

Control of bovine tuberculosis

The world at large is indebted to the veterinary profession for the control of bovine tuberculosis and for enabling the medical profession to approach the problem of tuberculosis in man more intelligently.

By tuberculin testing and destroying infected cattle, veterinarians have been instrumental in saving dairymen and farmers millions of dollars. This is only part of the story, probably not the most important part. They did their task so well in eliminating bovine tuberculosis and preventing its transmission to man that thousands of human lives have been saved. Medical journals of a few years past are filled with reports of bovine tuberculosis in man contracted through drinking unpasteurized milk from tuberculous cows and of operations performed for the removal of tuberculous glands from the necks of children. Rarely today does the physician, as he makes his rounds through the country, see the agonized expression on the face of the hunchback, or hear the screams of the child suffering from active tuberculous spondylitis or 'white swelling' of the knee or hip joint. Unfortunately, physicians cannot boast of similar progress in the control of human tuberculosis. Their problem does not offer so simple a solution. A strict moral code prohibits them from eliminating a human case of active tuberculosis, even though it is hopeless. As a result, tens of thousands of such cases spread the disease to their families and their friends who, in turn, become cases of active tuberculosis within a comparatively short time and likewise spread the disease.

Other diseases

Our debt to the veterinarian does not stop with tuberculosis for we have charted our course to coincide with his in the control of rabies, psittacosis, undulant fever, tularemia, anthrax, typhus actinomycosis, trichinosis, Rocky Mountain spotted fever, and possibly an unknown number of dermatoses. In each of these cases, it is necessary to know not only the nature of the disease in the animal, but the mode of its transmission from animal to man if progress is to be made in eliminating the disease from man. In this connection, it is particularly noteworthy that a veterinarian was the first to establish the fact that a disease may be transmitted from animal to animal or from animal to man by the bite of an insect. This fact was established before it was discovered that mosquitoes were vectors of malaria, dengue, and yellow fever; that the rat flea was a vector of typhus fever and bubonic plague; and that the bite of a wood tick which had fed on lower animals conveys the rickettsiae of Rocky Mountain spotted fever.

Rabies

Another definite contribution made by the veterinarian is in the prevention of rabies in the human being. Daily, by observation of animals that have inflicted wounds on human beings, veterinarians are advising physicians when the injured should receive immunization against the disease. Especially valuable is the aid they are furnishing to the Commissioner of Agriculture, the Superintendent of Public Instruction, and the State Commissioner of Health. Equally valuable is the aid given to representatives of organizations interested in drawing a law, for introduction at the next session of the General Assembly, to insure better control of dogs in Kentucky so that rabies may be reduced. This will be an important economic step, as rabies vaccine for human treatment in Kentucky last year cost the tax-payers $3,550·00 for indigents alone.

Brucellosis and other ailments

Much progress has been made in the elimination of brucellosis from dairy herds with the result that the debilitation on and deaths from undulant fever, transmitted largely through milk, have been greatly reduced. It is to be hoped that the day is not far distant when all cows producing milk for human consumption, whether family cow or cows in dairy herds, will be scientifically tested for brucellosis. This is a task for veterinarians, and we must depend upon them for the final control of this disease. And too, some means of closer cooperation between the veterinarian and those interested in wild life must be found to prevent tularemia among wild rabbits. Only in this way may we hope for complete elimination of this disease in man.

By the same token, if some efficient, economical, and practical method of extermination of rats could be discovered and generally applied, typhus fever, bubonic plague, and rat bite fever would be reduced to a minimum, while complete elimination of trichinosis in man could be effected by an efficient and practical means of detecting the larvae in the muscles of slaughtered pigs. This, too, is the veterinarian's task.

In recent years several widespread epizotics of equine encephalomyelitis have occurred in North America. These bear strong resemblances to human poliomyelitis and encephalitis, thus opening a new possibility for cooperation between veterinarians and physicians.

The two sciences

I might continue along this line, but it is sufficient to say that veterinary medicine has now reached the point where it constitutes an important and indispensable part of medical science in general. The two go hand in hand and have a common objective, namely the prevention of disease and the amelioration of suffering in all animals, both quadruped and biped.

The veterinarian has secured his place in medicine, in public health, and in each community he serves. New disease prevention and control measures, along with new ideas in animal care, will mean increasing public interest in veterinary medicine. Through cooperative efforts of groups such as this one, health departments, physicians, chemists, and the general public, the work, so ably begun in veterinary medicine, will continue to grow and public health will continue to thrive through the concerted efforts of your profession.

In the name of the Louisville and Jefferson County Health Department, the Louisville Medical School, and greater Louisville, I bid you welcome.—Reproduced from the *Journal of the American Veterinary Medical Association*, August 1947.

Home Gleanings

PALM-CANDY FROM FAR SOUTH

By S. V. KAMAT

CANDY manufacture is a lucrative profession mainly practised in the southern coastal strip of Tiruchendur taluka for centuries. In the third week of last July our Association had sent me to study the process and prevailing conditions. The following is a short note prepared out of my observations.

As I was a stranger to those parts and also to their language—Tamil, I had to get equipped with an interpreter. The ex-students of our Gram Sevak Vidyalaya have established in all parts of India. One Sri Kumaraguruparan is working in the neighbouring village of Sankaranayinarkovil, in north Tinnevelly. He became my host, guide and mediator by turns. His resourcefulness is mainly responsible for enabling me to finish this survey in the unknown wilderness with comparative ease and brevity of time.

The real centre

The season was nearing its end (it ended by 15 August), so we had to hurry along by the southern bus up to Tinnevelly and thence by the easterly train to Tiruchendur. Here enquiries revealed that Udangudi, a coastal village, 10 miles south of Tiruchendur, was the real centre. As that place was strange even to Kumaraguruparan, we secured some credentials and proceeded by bus. The route lay through saline waste-lands thronged with palms (thickly with palmyras and sparsely with cocoanuts). The fields were unsuitable for cultivation as the sandy soil was incapable of retaining water on its surface for a long time. Though the wells are dug up to 25 ft. the water-level was not deeper than 8 to 10 ft. this year. There is a narrow strip of cultivable land about four furlongs in breadth and ten miles in length, where betel leaves are grown with a negligible percentage of vegetables. To water these 'gardens', the labourers had to sweat over the 'aitas' or hand-cranes whose mainstay are sawed out of the long and strong bark of the plamyras. Besides this the land is practically bereft of any edible crops except, of course, the few cocoanuts, the abundant palmyra fruit, juice, *gur*, and candy.

South India, especially Tinnevelly District, is endowed with innumerable palmyras. Then why, I asked, out of all these palmy places should this far-off barren belt of land specialize in candy-making? As far as agricultural crops were concerned, it was a barren waste-land, that had deprived the population of their main employment—paddy cultivation. The unemployment that the geographical conditions had imposed seemed to be the main incentive to the ever-devising human brain to probe deeper in the palm-*gur* industry and develop it into a refined art of candy manufacture. Palm-*gur* making was, and still is, a subsidiary vocation to agriculture in other parts. But there it had to be evolved into a wholetime profession. When nature had forbidden man to work as a simple farmer, he had to transform himself into an artisan—an adept in preparing crystalline candy.

Udangudi is a large village, consisting of more than 12 thousand inhabitants spread over the cultivable strip for two miles or so. Like all coastal territory here also the houses are not grouped together but are laid all along the roadside. There is a Group Congress Committee, which is being at present run by the youths of the 1942 movement. We at first went to them and after some persuasion, the Joint Secretary acceded to our request to escort us to a nearby centre. But he seemed to wield little influence over the man-in-charge there. The Joint Secretary seemed to realize this shortcoming of his, and promptly began to seek some other person, and, fortu-

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nately he succeeded. We were able to see various centres, tappers, merchants—and went through all the practical processes of palmyra candy manufacture.

Out of all these various visits and interviews, the first was the worst. The factory was owned by an obtrusive, named Krishna Konar. Before he could fully bring forth his conservativeness into operation I was able to see some part of his shed and also some of the processes. He talked to us quite a lot, through which we could elicit much information. But as to any further 'sight-seeing' into his processes, he asserted his firm negation. Next morning we managed to secure the help of an influential Muslim merchant, on whose account Konar seemed to endure our second visit. After wailing out a long list of his sufferings he declared that the best way of introducing this industry in other provinces was by requisitioning the services of experts like him, who would then (and only then) be able to demonstrate the intricate technique of candy-making. Still I dared to ask him to take us around his 'refinery', to which he politely expressed his inability. I put forth all the patience that was in me to control my restlessness . . . And came away.

This ill-begun exploit gave us sufficient scope and material to brood over the prospect of my future study. The Congress workers seemed to be at a loss to find us any new avenue for our survey. We discretely prevailed upon the benevolence of the Muslim merchant, Moula Ali, who told us that once he was the host of honour to our boss Kumarappaji, when he had visited those parts. After hearing his eloquent repast in his Tamilized English, he bestowed us with another servant, who successfully steered us to the southern centres.

Necessary information

With the help of this and another guide we could visit five more candy centres. Before leaving the place I had handled all the feasible details, and as far as the preparation of candy was concerned I had a satisfactory experience. We could also interview some tappers and the only wholesale candy merchant, who willingly supplied us all the necessary information. I summarize it in the next paras.

The tapping season is from mid-May to mid-August. A candy-maker usually employs three to six tappers. Nira, the sweet palm-juice, is boiled into rab to the consistency of 108°C. At this point the boiling syrup from the earthen pots over the furnace is quickly laddled out in a palmyra-leaf container, through which it is carried to big earthen jars that are buried to the neck in sand in a nearby hut. The capacity of these storage pots, in which the rab crystallized into candy, was more than 80 lb. It was necessary to fill the jars within two days, so as to ensure proper crystallization. Therefore unless there was sufficient juice (say 300 pounds) to produce at least 40 lb. of rab candy-making did not begin. Usually it started in the first week of June and stopped after two months.

As soon as the jar was full, some 8 to 10 tiny sticks of a local bush named *Karandy* were inserted in it vertically. Then it is let alone for the next 40 days, during which crystals are formed around the *Karandy* sticks and also on the inner surface of the jar, half of which is 'solidified' with fine crystals of minor dimensions. After taking out the bulging *Karandis*, the other crystals and the remaining syrup were emptied over an improvised 'filter' (an inverted bottomless jar with a piece of perforated mat at its mouth). To collect the oozing molasses a pot was placed under. The crystals remained there for 24 hours, after which they were dried by spreading them on a mat.

Economics

Like all other home industries here also it was practically impossible to isolate its economics from other intricacies. A close investigation and a persistent enquiry into what they termed as trifles, disclosed an inkling of the statistical data required for the purpose. On the strength of that I have based the following deductions.

A tapper taps 30 to 40 trees, drawing, on the average, at least 180 to 200 lb. of Nira every day. The boiled rab of this would amount to 30 to 35 lb. out of which approximately 8 lb. of candy and 20 lb. *gur* is produced. The former would fetch him something more than Rs. 4 and the latter Rs. 3. The total returns of the two months of candy manufacture would thus run over Rs. 400. This would be subsidized by another 100 rupees that are earned by the sale of *gur* that is produced before and after candy-making.

It was equally difficult to calculate the expenses. Besides food and some cloth the actual sum paid to the tappers varied from Rs. 150 to 200. There was a woman boiler for every three tappers and two other females to collect fuel, who were likewise fed, clothed and paid Rs. 30 each at the end of three months. All these wage-earners were temporary emigrants from the Cape Comorin area. To escape all these complications in estimating the actual costs, I have hit upon the device of finding the seasonal income of a tapper family consisting of at least three males and three females. Then the money actually spent by them for the industry would be on tree-rent, shed, pots, lime, etc. All else would be their earning:

Tree-rent Rs. 200; earthen vessels for collecting and boiling Rs. 100; storage jars Rs. 100; sheds Rs. 100; sundry Rs. 100; total Rs. 600. Three tappers would produce candy and *gur* worth Rs. 1,500. So the net remains to a family of six comes to Rs. 900 at the end of three months. But the primary condition that enables them to earn this lucrative sum is that they, at least six of them, must put in a united effort and should be able to invest at least Rs. 1,000 because for the first two months or so no returns could be expected as all the available juice was boiled and deposited for crystallization. As the meagre resources of the average tapper could not amass this 'wealth', the well-to-do community (the petty bourgeois class) of the village had stepped in and this hire-and-lease system was established, in which the hard-working tappers received the least while the supervising overlords the most. Unless some genuine cooperative society financially helped them and pooled their solitary toil into suitable units ranging from three to eight tapper families, there seemed to be no other solution to improve their lot.

As stated in the beginning, ages ago, when man first thought of establishing in this narrow coastal strip, nature must have dictated him to discover this craft of candy-making. He prevailed upon the crude materials that were then available, and then seems to have turned his back towards the further progress of civilization during the later centuries. The industry is in the same old primitive condition. The slow unscientific boiling involves more fuel, labour and time. Moreover they are negligent enough to retain the lime which chars and embitters *gur*. The meagre resources, the strenuous effort the industry entailed, utter ignorance of the modern scientific devices and lack of will or wish to get them simplified to suit their environment, were some of the reasons why the industry had not made any headway.

However, I was content that all that was to be learnt in this industry was, after some effort, made available to me. The various observations had inculcated a fair amount of confidence so as to carry on an independent experiment of our own. Of course I had some technical doubts regarding the difference in the quality of juice, climate, soil, etc. but all these could be cleared or ascertained only after the experiment was conducted.—Reproduced from *Rural India*, November, 1947.

Book Reviews

CHEMICAL COMPOSITION OF PLANTS AS AN INDEX OF THEIR NUTRITIONAL STATUS

By D. W. GOODALL and F. G. GREGORY (Published by the Imperial Bureau of Horticulture and Plantation Crops, August 1947, pp. 167+bibl. 936, Rs. 9).

THIS is a monograph full of closely packed information in which the authors have attempted to estimate the value of plant-analysis methods with the critical acumen necessary for successful research. The results of previous workers have also been carefully collected and assembled in a manner of great usefulness.

It is often claimed that the composition of the plant reflects its nutritional status, the adequacy of nutritional supplies and the probability of its response to increased supplies. The examination of these claims forms the principal topic of this highly useful monograph, the ultimate object of which is to obtain a solution of the 'Central problem—the determination of fertilizer requirements'. The book starts with an introductory review of the different methods of assessing fertilizer requirements and a detailed consideration of the various methods which have been proposed and attempted, finally coming to the use of plant analysis and comparison of the values with those of other techniques.

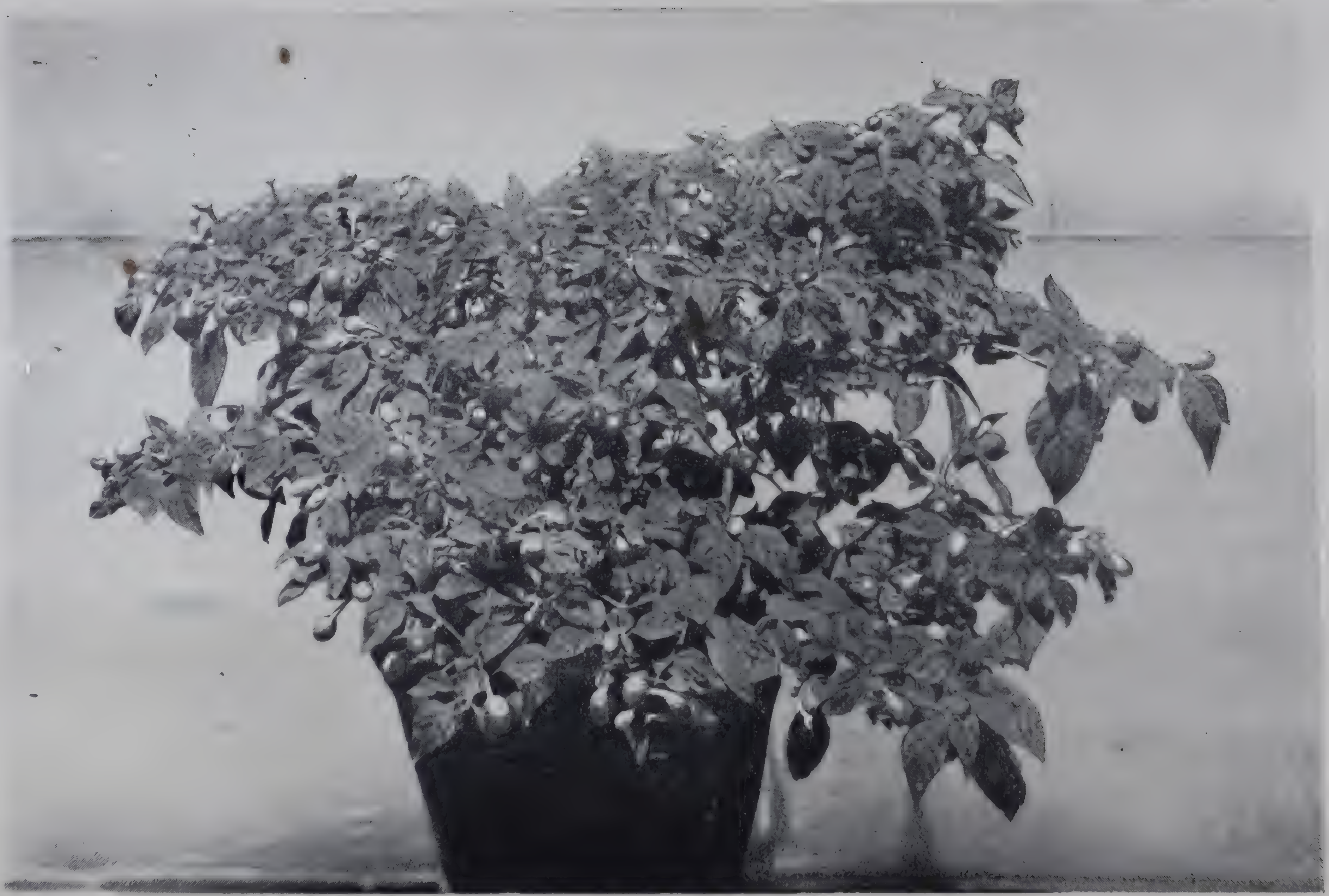
There are in all 15 Tables of which (Table I) extends over 16 pages giving the published data of the content of nutrients in plants showing symptoms of nutritional disorder. These have been reproduced in summary forms and contrasted with data for otherwise comparable forms not showing the symptoms. Similarly Table II gives the limiting value below which deficiency symptoms and above which toxicity symptoms may occur. Another Table (Table XII) gives the standard values of nutrients content proposed in the literature. These are as much interesting as useful.

The author-index covers over 800 entries. The bibliography gives the titles and references of the papers and publication, whereas the 'subject index' and 'author index' are put up separately. The arrangement thus facilitates easy reference.

The correct criterion for assessing the value of any method for the fertilizer requirements depends on the accuracy with which the response to fertilizer additions can be forecast. The pre-requisite for it is a series of comprehensive experiments in which the samples of plant material have to be taken for analysis before the fertilizers, whose effects are to be predicted, are applied. The chemical composition of the plant, if estimated at the right stage, offers a great saving of labour besides the fact that the results can be obtained with very little delay. This has prompted the authors to give a general survey of the use of plant analysis for diagnostic purpose showing the main lines of development during the last two decades. Here 'tissue tests' method deserves special mention on account of the rapidity with which it enables determination of the deficiency. The theory behind this method is based on the natural probability that the nutrients present in the conducting tissues consist largely of unassimilated materials and hence their concentration will represent their current rate of intake. The senior author in particular has done considerable work relating to the diagnosis of mineral deficiency. The 'tissue tests' method holds out great promise and needs to be tried on a still wider scale.

The book is an epitome of great care, erudition and labour and will be of great service to all research workers.

Incidentally, it reveals how little work on these important aspects have been conducted in India. (I.C.)



'Sinaha' chilly grown at Paddy Breeding Station, Mangalore

PLATE 24

'SINAHA' CHILLY

By K. HANUMANTHA RAO and M. B. V. NARASINGA RAO

A VARIETY of chilly, 'sinaha', is being grown at the Paddy Breeding Station, Mangalore, in South Kanara District of Madras Presidency since the last two years. Two seedlings were raised from a few seeds kindly spared by one horticultural enthusiast who got them from a friend in Ceylon. The seedlings commenced to bear within four months after transplanting and have since been continuously and profusely bearing, the plants being manured periodically. The fruit is medum-sized, round in shape, and develops different colours at the different stages of its maturity; fruits are light green in the early stages and through shades of purple in the growth turn dark red at maturity. The chillies are slightly more pungent and possess the same flavour as of the normal chilly. Seedlings can be raised with considerable ease and fresh seeds collected from plants have given 60 to 85 per cent germination within two to three weeks after sowing and produced healthy seedlings fit for transplanting within two months of sowing. Being a continuous and prolific bearer, the variety requires naturally a rich soil and periodic manuring. The plants come up well both in the open ground as well as in pots kept in partial shade. They produce a number of side branches even from the very bottom soon after they establish and therefore pinching of the young side shoots up to about 3 to 4 in. from the ground level, helps to give the plants a longer stem and good shape.

The colour of the fruits and the shape of the plant are attractive. The plants are attracting the attention of every visitor to this Station and there has been a very large demand for their seeds and seedlings. The variety should be a valuable addition to any garden from ornamental as well as utility points of view. The seeds of the variety can be obtained from the Officer-in-charge, Paddy Breeding Station, Mangalore.

RECLAIMING LAND FROM THE SEA

SEVENTEEN farmers have combined with engineers to undertake a big reclamation scheme on the east coast of Britain which will win 1,400 acres of new arable land from the sea.

In a race against time and tide they have set themselves the task of building a sea-wall five-and-a-half miles long in 17 weeks. The whole success of this farming adventure depends on completing the wall in time to prevent high equinoctial tides next September from flooding the land to be reclaimed.

The reclamation scheme is being carried out in Lincolnshire on the north coast of the Wash. At present the land is a desolate stretch of salt marsh which is covered by sea to a depth of several feet at high tides each spring and autumn.

As soon as the new wall has been built to a height of 12 feet, farmers will start the work of reclamation. The land will be ditched and drained and within two years the first crops will be planted. An analysis has shown the soil to be rich in potash and nitrogen. When the new area of arable land has been brought under cultivation it is likely to make a valuable contribution to Britain's food production drive.

The idea was conceived by a group of enterprising Lincolnshire farmers who have formed themselves into a non-profit-making company for the purpose of carrying out the scheme. When the work is finished each farmer will receive a share of the reclaimed area adjoining his present property. They have the full support of the Ministry of Agriculture in this project.

The immediate task of building a sea-wall entails raising some 400,000 cubic yards of earth. Bulldozers and giant excavators travelling on wooden ramps are already in action on the water-logged marsh land. The new wall will run parallel to a similar bank built half-a-mile inland nearly 150 years ago. Further back is another wall raised by the Romans. Gradually, throughout the ages, silt has been swept in by tides and has formed on the seaward side of the walls. Inch by inch the sea has receded leaving behind it tracts of salt marsh.

To-day human enterprise is assisted by modern machinery in reclaiming land from the sea at a time when every additional acre brought under the plough is of vital importance to the national economy. (*B.I.S.*)

COVER ILLUSTRATION

Village cattle in Bundi.

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 9
SEPTEMBER 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.9.48
2,800

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London WC 2.

INDIAN FARMING

SEPTEMBER, 1948

Vol. IX No. 9

POSSIBILITIES OF REFRIGERATION IN INDIA*

IT gives me great pleasure to welcome all of you who have responded to our invitation to attend this first Refrigeration Development Conference to be held in the country. I hope that your labours during these two days will place the programme for the introduction of refrigeration plants in India on a firm foundation so as to serve the interests of the large masses of India's agricultural population.

Refrigeration based on electric power is a new thing in India. It is obviously one of the coming things in our country. Machinery has value if it helps man without rendering him workless. Refrigeration plants can serve this purpose. Man produces food. If he does not take precautions, pests destroy it while it is in the field and insects and animals destroy it when it is reaped and stored. The climate also can affect it in both places. It has been estimated that last year 33 million tons out of the foodgrains produced in the world were destroyed by insects, fungi and rats. This is about the quantity which is available for sale to deficit countries. That is, the world's surplus could be doubled if these enemies of food could be defeated. In India the destruction of foodgrains by these enemies has been calculated to be about 30 lakh tons which is equivalent to our maximum food deficit in recent years. If we but could save all this, we need import no food from outside nor would we feel any scarcity of food in the country. The preservation of food is therefore a very important question. It is so in India as it is all over the world, and we would fail in our duty if we do not give it due attention while handling other problems relating to food.

Since ancient times, the Indian villager has adopted indigenous methods for preserving grain after it has left the field. Underground and aboveground storage pits and bins were a common feature in the rural parts of India. They have not wholly disappeared from there even now. It is also known that Indian rulers of the past used to store large quantities of foodgrains against famine years. We seem to have lost the ancient art of preserving foodstuffs. We must improve the present technique of food preservation in the rural areas. I would venture to appeal to our scientists to investigate the possibility of making improvements in indigenous methods of preservation. How to save the present loss due to infection or deterioration is a big problem. It has, however, to be tackled in the interests of our agricultural masses no less than in the interests of the objective of food self-sufficiency for our country.

I realize, however, that the present Conference has a very limited objective. Instead of considering the entire problem of food preservation, we will be dealing during these two days with the problem of preservation of that part of our foodstuffs which are styled as perishables. Among these perishables are included potatoes, fresh vegetables, fruits and fish. The programme is to encourage the construction of storage plants based on the principle of refrigeration. There are today in India 65 refrigeration plants. These are situated in a few large cities. In this industry, as in the case of others, the initiative has been taken by private industrialist who, guided by the profit motive, is introducing in India what he thinks is both new and needed. Since it is needed in the interests of the people, Government have felt it their duty to encourage this industry.

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*Speech delivered by the Hon'ble Shree Jairamdas Daulatram, Minister for Food and Agriculture at the Refrigeration Development Conference held on 19 and 20 July, 1948.

The industry is yet in its infancy. It has been organized in the course of only the last three years. The Ministry of Agriculture has taken steps to popularize the use of refrigeration plants and to assist the setting up of more of these plants in different parts of the country. But we are still greatly behind many European countries. A few figures will illustrate how backward our own country is in the matter of providing refrigeration facilities for the preservation of our eatables. In a country like the U.S.A. there are 5·7 cubic feet of cold storage per man, in New Zealand the figure is 27·2 cubic feet per man, in Australia it is 2 cubic feet per man, even in a country of such cold climate as the United Kingdom it is ½ cubic foot per man, whereas in India it is only 1/70th of a cubic foot per man. That is, U.S.A. has 400 times the facility which India has, New Zealand has 1,900 times, Australia 140 times and U.K. 35 times. These are very telling figures proving the utter inadequacy of the present effort in the context of India's full needs. We have been storing in this limited space less than 2 lakh maunds of potatoes as seed for the next year's sowing season. Small quantities of oranges are also saved from deterioration by the use of cold storage. Our Refrigeration Development Engineer informs me that by next hot season we hope to have another 5 million cubic feet of cold storage. It must be realized that during these three years of pioneer work, encouraging results have been achieved and the demand for cold storage has been on the increase. But as I have said, we have so far touched merely the fringe of the problem. So long as refrigeration will depend on electric power, its progress is conditioned by the availability of the electric current. This condition today bars out most of the rural areas from the use of electric refrigeration. It largely confines the benefits of refrigeration to cities and towns and inevitably to the richer section of the people, the large merchant and manufacturer.

This factor has given rise to several problems which need careful consideration in the interests of the people as a whole. Methods must be discovered to bring the benefits of refrigeration to the smaller towns and larger villages of India in the sense that those who themselves produce foodstuffs which are perishable should be able to take advantage of the cold storage plants available in bigger towns. Their goods must be transported without the risk of deterioration, lodged in the storage plants on their account and remain available to them. If there are difficulties in this method being adopted, the cooperative organization must come into the field to assist the small producer to preserve his perishable foodstuffs till the time he is in a position to dispose them off, utilizing for the purpose the cold storage plants of the bigger places. In the alternative, cheaper methods independent of the electric power must be discovered to help the small producer or trader in the smaller towns where for long remains a large proportion of the perishable foodstuffs, primarily the product of the rural areas which do not enjoy the benefit of electric power. The problem of preserving perishable foodstuffs will have been inadequately dealt with if they are not preserved while they remain in the villages and small towns.

Some of the problems arising out of the present situation will be coming up before you for discussion and decision. I trust that in dealing with them you will have more the interests of the people at large in view rather than your own individual benefit. The refrigeration programme as also those who are developing it in the country must both subserve the good of the masses and not of a few. It is in that context that I would welcome special efforts being made to build up cooperative cold storage plants in a central town of which the growers of the surrounding rural areas would be co-owners. These would jointly contribute to the setting up of such a plant, these would share in its management and these would receive benefit and profit from them. It is in that same context that the Conference will be requested to consider the proposal that the Government should in the larger interests of the people participate in the ownership of this industry. This participation may be of value to the industry itself as the co-ownership of Government may facilitate the import of refrigeration plants and machinery and make more easily available electric power, water supply, building materials and other requisites for the efficient working of this industry. In the same context has been suggested another item of the agenda for your consideration. It relates to the need of Government retaining power to examine the basis on which the owners of cold storage charge rent to the producer and the trader and to take steps from time to time to see that the rents are fair and reasonable and so designed as to popularize the method of cold storage in the interests of preservation of the country's food.

Another important subject will in due time be coming up before you which would need your careful consideration. Ever since I had to study the state of things in regard to the refrigeration industry in India, I formed the view, which has been strengthened by further experience, that our organizational machinery for the progress of this industry is hopelessly inadequate both at the Centre and in the provinces. At the Centre we have only one solitary man who knows anything of this technique. I believe the provinces are even worse off. If we compare the organizational strength of this section of the Agriculture Ministry with many European countries, we will be surprised at our own, shall I say, daring, in launching upon a new venture with almost no technical staff. The creation of the necessary skilled personnel is a top priority matter. We must somehow create immediately an efficient training centre in India and draw towards it adequate number of competent young men with engineering qualification and experience and from year to year turn out reliable progressive and able refrigeration engineering staff which would supply the motive power for the full development of the cold storage technique not only in the larger towns but far out in the countryside by all methods that are suitable to local conditions. Without rapid advance in this direction we can make no substantial headway in our efforts to preserve for the people what nature has rendered perishable.

I need refer only to one other item of your agenda in view of its comparative importance, before I conclude. There is a proposal to have an Advisory Committee for the refrigeration industry. It is my hope that in settling the composition and powers of this Committee your recommendations while recognizing the interests of the Government, the industrialists and the traders, will not ignore the interests of our small producer and in a general sense of the people of the rural areas. As I have indicated then, this industry also must serve the interests of the vast masses.

After all we hold power and we govern for the sake of and in the interests of the masses who so predominantly live in the villages and the problem of preserving food relates also largely to the rural areas where food is produced and where it remains for a good part of the year. The method of safe storage, whatever its basis, must extend itself far beyond the bigger towns. It must extend where electricity may not exist. America uses refrigerated cars based on the use of 15 million tons of artificial ice, one-third of the ice which that country manufactures. India is expected to produce soon, 60 thousand tons of ice for all our purposes, and part of it may come to be used for refrigerated vans to link big cities with small towns for the purpose of preservation of perishable foodstuffs. But I would go even beyond artificial ice as the basis of safe storage for the rural parts. We must devise other and cheaper methods of preserving perishable foodstuffs or even other foodstuffs. I have appealed in the earlier part of my address to the scientists of the country to design improvements in our traditional methods of safe storage and discover for the villages and small towns, which produce and retain for many months of the year a predominant proportion of our food, means which are simpler, cheaper and more within the reach of the large masses of our producers. Thus alone shall we be in a position to save India's food which today is destroyed by pests, insects and the ravages of climate. We will have saved in the process enough to avoid our importing a single ton of the food-grains from outside and will have spared a 100 crores of rupees for national programmes of progress and service. I know that the present Conference is meeting for a far more restricted purpose. I wish we could before long gather together a wider circle of co-workers to deal with the far bigger objective which I have just indicated.

I have great pleasure in inaugurating this Conference and have every confidence that your recommendations will be shaped by sound judgment and inspired by patriotic motive. I will be looking forward to receive before long the result of your endeavours during these two days. I would now request you to proceed with the consideration of the agenda placed before you.

Original Articles

FISH MEAL FROM SHOALING FISHES OF THE MADRAS PRESIDENCY AND THEIR ROLE IN ANIMAL NUTRITION*

By S. T. CHARI and P. ANANTHA PAI

FISH meal has been defined officially in America as a clean, cooked, dried, ground tissue of undecomposed whole fish or parts of fish. In both the United States of America and Canada the immense Menhaden fisheries and bulk of the catches in other important fisheries like Pacific Herring and Sardine are utilized for conversion into oil and meal, the name 'reduction' being employed to describe the process. The plants are designed for continuous operations, the raw materials being fed at a steady rate from storage hoppers to the cooker from where they are conveyed to the continuous screw presses without interruption. Extreme care and scrupulous precaution are bestowed both in the selection of the raw materials as well as in the actual processing with the result that high grade finished products are obtained. If the fish is stale, the pressed residue is treated with commercial sulphuric acid and marketed as acid-manure; if the fish is fresh, it is carefully cooked, dried, powdered and used as a feeding-stuff for poultry and cattle.

Developments of the industry

A flourishing industry of fish oil and guano, mainly from the abundantly shoaling Oil Sardine (*Sardinella longiceps*), existed on the West Coast of the Madras Presidency. This was the outcome of the extreme interest of Sir Frederick Nicholson, the then Fisheries Director, who encouraged private capital to flow into our fishery industry and introduced the improved method into the trade, viz. that of cooking and pressing the fish for oil, in the place of the primitive and highly objectionable process of allowing the fish to rot and skimming the dark, smelling oil. The business was so lucrative and attracted such attention that as many as 650 factories sprang up within a few years in the 250-mile stretch of the West Coast line from the northern border of the South Kanara District to the southernmost point of the Malabar District. The decades from 1920 to 1940 showed a steady migration and disappearance of Sardine shoals from this coast, a decline in the catches and a decrease in the number of factories. It was, however, found out between 1920 and 1940 that the pressed cake from untainted fish, hygienically dried and powdered and sterilized, could be more economically utilized as a nutritious feeding-stuff for cattle, pigs and poultry.

The Tanur Experimental Station conducted certain preliminary experiments on feeding livestock with fish meal before it began the systematic manufacture and sale of fish meal between 1925 and 1940. Though the Station was closed under the stress of the War in 1940, its activities were restarted in 1945 under the name of the Fisheries Technological Station in Calicut. Now it is considered necessary to conduct experiments in all the shoaling fishes which are cheap and convert them into fish meal and find out their composition and feeding values. The preparation of raw meals are conducted at the Fisheries Technological Station and complementary feeding experiments are planned in collaboration with the Indian Veterinary Research Institute, Izatnagar.

S. T. CHARI and P. ANANTHA PAI are Research Assistants in the Fisheries Technological Station, Calicut.

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*Published with the kind permission of the Director of Industries and Commerce, Madras.

Manufacture of fish meal

The nutritive value of the fish meal is influenced by the type of fish used, the season and the care bestowed in cooking, pressing or drying and storing.

Fishes so far used for the manufacture of meal are:

1. Mackerels (*Rastrelliger kanagurta*) both gutted and un-gutted.
2. Soles (*Cynoglossus semifasciatus*).
3. Horse Mackerels (*Caranx crumanophthalmus*).
4. Anchovis (*Engraulis* sp.).
5. Ribbon fish (*Trichiurus savala*).
6. White bait (*Stolephorus* sp.).
7. Oil Sardine (*Sardinella longiceps*).
8. Sharks (*Carcharias* sp.).
9. Skates (*Rhinoptera* sp.).
10. Dolphins.

Mackerel is the chief shoaling fish of the West Coast and to some extent of the East Coast, especially of the Northern Districts. Although it is in demand as food for human beings, both in the fresh condition and as salt-cured, the magnitude of the fishery is such that even after meeting these demands a fair portion is left over which is sun-dried on the beach as a low class food or manure. There is thus scope for the better utilization of the residue as fish meal, by cooking and pressing it especially during the months of October and March.

The Soles occur in shoals occasionally during monsoon months. The highly-prized Soles of the Western countries have very little attraction for the Indian population. But being watery, they give a very concentrated meal when cooked in their own water, pressed and dried. Irregular but abundant shoals of Horse Mackerel, Anchovis and White bait also occur during this season. The first being a coarse-fleshed fish is not much in demand for consumption in the fresh condition. The second being too fatty is not very much suited for salting (the only available method of preservation) because of the rapidity with which rancidity sets in the cured product. Ribbon fish fishery is one of the economically important monsoon fisheries in our land. Oil Sardine, the once esteemed and an economically important shoaling fish, is not available in plenty at present. Sharks and Skates are evidently not shoaling fishes, but they occur with the shoaling fishes in fairly large quantities. As their demand in the fresh condition is limited, they can be also considered as raw materials available for fish meal. With the greater exploitation of our deep seas with vessels equipped with power and improved gear, the catches of these are expected to be much greater than at present and as such raw materials will be available in greater abundance for conversion into fish meal. Dolphin fishery remains unexploited in our land in spite of its vast possibilities. But as human food, it has very little demand, owing to religious and sentimental objections, and as such it has a future as a fodder industry.

The method of preparation of fish meal out of these fishes can briefly be described as follows:

Big fishes are cut into pieces; liver and entrails are removed and the small fishes are treated whole. They are cooked in open vats in water. Reasonable control of cooking is essential since it is desired to break down the oil cell in oily fishes during the cooking operation, while over-cooked or soft fish is more difficult to press. The period of cooking will vary with the size, nature and freshness of the fish. For medium-sized fishes like Mackerel in fair condition, 10 to 12 minutes contact with boiling water gives sufficient cooking. Fish can be considered cooked when the blood in the large blood vessels under the back bone is coagulated and the tissue between the vertebrae is shrunken or when the eye-balls are white. A loss of material may result from improper cooking. The purpose of cooking is to break down the body cells in order that better yield of oil in the case of fatty fishes may be obtained in the pressing operation and fat content in the final product may be kept low and also to prevent the enzymic decomposition of tissues and make them more easily digestible. If the fishes are under-cooked, the recovery of oil will be decreased and consequently, the fat content in the dried scrap will be high, which is not desirable and is an economic loss. If they are over-cooked the flesh disintegrates and there is an increase in the amount of protein material squeezed through while pressing, and lost with the pressed juices.

Pressing the fish after cooking in canvas or coir press bags under a vertical screw press must invariably be done whether the fish meal is prepared out of fatty or lean fishes ; pressing effects a reduction in the moisture contents and a homogeneous pressed cake of uniform low water content is obtained and this helps quick drying. In our experiments, the yield of fish meal ranged from 14 to 20 per cent of the fresh weight of the fish as can be seen from Table I given below :

TABLE I

Percentage yield of fish meal from fresh fish

No.	Name of fish	Weight of fish in lb.	Weight after gutting in lb.	Cooked Weight	Weight after pressing in lb.	Weight after drying in sun	Percentage yield to raw weight
1.	Mackerel (gutted)	54	43·5	35·5	20	7·87	14·6
2.	Mackerel (un-gutted)	54·5	..	45	26	9·25	17·0
3.	Soles	268	..	206·5	119·5	45·0	16·5
4.	Horse-mackerel	82	..	68	42	12·25	15·0
5.	Anchovies	82	..	70	36	21·0	17·3
6.	Ribbon fish	40	..	36	19	6·0	15·0
7.	White bait	100	..	84	50	16·25	16·3
8.	Oil Sardine	50	..	43	19·5	8·0	16·0
9.	Sharks	40·5	31·5	30	28·5	6·5	16·3
10.	Skates	55	52	48	38·5	11·0	20·0
11.	Dolphin	28	26	23·5	11·5	5·0	17·5

Composition of the various fish meals

The fish meals as prepared above which at this stage can best be called as press coke, are quickly and completely dried in the sun and stored as scrap till required. It is then ground to a fine nice powder so as to pass through a 40 mesh sieve. From the bulk quantities representative samples were taken and analyzed for their food values.

The methods of analysis are the same as followed by the Association of Official Agricultural Chemists (1945), viz. estimation of water by air-drying at 100° C, protein by the Kjeldahl method for nitrogen and multiplying the nitrogen factor by 6·25 to arrive at the protein, fat by extracting with anhydrous ethyl ether for about 12 hours in a Soxhlet apparatus, and ash by heating the sample to dull red heat till the colour becomes white, P_2O_5 by the ammonium molybdate volumetric method, and calcium by the permanganate method, precipitation of the calcium being done at pH 5·6, sodium chloride by the Carius method and insolubles after ash extract with hydrochloric acid.

The analytical values of the various fish meals under study are given in Table II below :

It will be seen from the Table that there is a column 'un-identified' and this is the difference from 100 after totalling the moisture, protein, fat and ash contents. Fish meals are known to contain only about 1 per cent of crude fibre and so the values under this column can be taken generally as carbohydrates.

In Mackerels, two analyses have been done, one on the gutted and the other on the ungutted Mackerel fish meals. The values show that there is a difference in the protein and ash contents—the sub-analysis of the ash showing a distinct amount of insolubles in the case of the ungutted meal. Since there is no external contamination of sand during preparations, the high sand content in the latter can be probably due to the sand and mud contained in the food taken by the fish. The quality of the meal as can be inferred from Table II

TABLE II

Analytical values of different fish meals

No.	Name of fish meal	H_2O per cent	Protein per cent	Fat per cent	Ash per cent	Uniden-tified per cent	P_2O_5 per cent	CaO per cent	Sodium chloride per cent	Insolubles per cent
1.	Mackerel fish meal (gutted)	8·73	68·06	5:79	16·2	1·22	6·69	7·92	0·34	0·52
2.	Mackerel fish meal (un-gutted)	8·70	62·10	6·11	20·71	2·38	6·88	9·00	0·23	2·87
3.	Sole fish meal	6·08	61·42	9·01	18·05	5·44	2·75	6·22	0·10	2·77
4.	Horse-mackerel meal	10·26	60·05	4·11	16·99	8·59	5·37	6·68	0·27	0·56
5.	Anchovies fish meal	8·51	62·66	4·00	20·43	4·49	4·92	7·37	0·41	2·53
6.	Ribbon fish meal	7·90	72·21	6·55	12·98	0·36	3·78	5·35	0·23	0.11
7.	White bait meal	5·51	68·25	8·34	15·91	2·00	4·03	4·86	0·40	2·30
8.	Oil Sardine meal	9·68	65·27	9·54	14·77	0·75	5·79	6·01	0·32	1·78
9.	Shark fish meal	9·87	77·84	5·31	7·46	..	3·00	2·79	0·49	0·13
10.	Skate fish meal	6·54	77·93	2·19	10·42	2·92	3·93	0·04	0·62	0·25
11.	Dolphin meal	4·25	69·71	6·91	14·53	4·61	5·96	4·89	..	0·88

is improved by gutting the fish and cooking it rather than preparing the meal from whole, round fishes. Our Factory experimental data on the percentage yield in the case of the gutted is 14·5 per cent and in ungutted fish meal 17 per cent. Although the quality of the meal is slightly improved by gutting, considering the higher percentage of yield, labour costs for gutting and a standard quality fish meal obtained in un-gutted meal preparation, we conclude that Mackerels and smaller shoaling fishes can be converted into fish meal with advantage from whole fishes. All our fish meals other than Sharks, Skates and Dolphins were prepared from whole fishes.

It will be seen from the same Table that the food values of all the fish meals under study are high. The moisture content is well within 10 per cent, protein ranging from 60 to 78 per cent, fat 2 to 9 per cent, ash 10 to 20 per cent, P_2O_5 and CaO 3 to 7 per cent each excepting in the case of Skate which shows about 0·3 per cent. It is of interest to note a rather low percentage of CaO in the case of Elasmobranchs (Sharks, Skates, etc.) when compared to the Teleostean fishes. This may be due to the absence of well-formed bony skeletal structures in the former. For comparison of our fish meals, the standards and specifications required for a non-fatty fish meal by Feedstuffs Acts of various countries are given in Table III below:

TABLE III

Standards and specifications of a non-fatty fish meal

	H_2O per cent	Protein per cent	Fat per cent	Calcium phosphate per cent	Insolubles per cent
Berlin	14	62–66	2–6	13–16	Less than 2
Netherlands	12	60	4	..	..
United Kingdom	..	Not Less than 55	5	Not Less than 16	..
Canada	14	55–60	Less than 10	..	..

So the fish meal analysis as given in Table II proves the excellent quality of the various meals, and is well within limits in many respects. However, Shark and Skate fish meals deserve special mention. They are fine, flaky powders of low moisture and fat contents and are very high in protein. It is interesting to note that though the livers of these Elasmobranchs are very high sources of oil, the flesh contains practically no oil and is well-suited for preparing high protein fish meals. These may be classified as the 'lean' or 'white' fish meal of Western countries.

The other fishes contain varying amounts of fat in their flesh and pressing helps to bring down the fat contents in the final product. The objection to a high fat content is that it will cause the meal to deteriorate and rancidity will set in. Also a high fat content is not very conducive for easy digestion of the feeds by the animals and lowers the relative quantity of protein and mineral contents.

Other limiting factors in the quality of meal are moisture, sodium chloride and sand. The high water content is naturally unwanted since it increases the weight of the meal, helps in the deterioration of the meal by the formation of fungus and moulds, quickens any internal chemical action and increases the decayed fishy odour. The presence of salt helps the meal to absorb moisture when exposed to air. Though it is a constituent of blood and a small quantity administered daily will keep the animals in tone, any excess of salt creates thirst in animals and careless drinking of water from polluted sources causing infections and disease. A high salt content is more harmful to pigs and poultry than to cattle. Three per cent of salt should be considered the minimum permissible in ordinary fish meals. Sand is an adventitious product present by careless handling or by wilful adulteration. It should not be above 1 per cent as it only adds to weight and serves no other purpose. From the foregoing, it will be clear that fish meal should be bought only after analysis.

Importance of fish meals to cattle

The meals comprising of high protein and mineral contents can be fed to all classes of livestock (poultry, cows, buffaloes, etc.). They supply concentrated sources of valuable tissue and bone-building materials. These animals produce many times their weight in food materials such as eggs and milk each season, and it follows that large amounts of proteins and minerals must be supplied in order to replenish the tissues and bones that are used up for the production of milk and eggs. Many of the feeding stuffs (like grass, hay, corn, seeds and other vegetable matter) used in the feeding of the animals contain very low amounts of tissue-building materials and hence the inclusion of fish meals in their diet will be a very good supplement to a high carbohydrate diet. The calcium in the meal which is also mainly derived from the crushed bones of the fish in the preparation, is in an easily digestible form and the digestibility of the proteins of fish and fish meals has been well-established. The fish meal is also noted for its vitamin contents, chiefly A, D, G and K.

Prejudices in the use of fish meals

When the value of fish meal, as a cattle food, was first recognized, people in their anxiety to fatten their livestock began to give disproportionate quantities of fish meal, and quick results were produced. At the same time it created a strong prejudice in others and the story gained ground that the animals fed with fish meal, after slaughter, become tainted very soon and impart a fishy odour. Even the milk derived from the cows fed with fish meal was reported to go bad after a short time and also impart a fishy flavour. These have been proved to be incorrect and unfounded. In India too, the use of fish meal was not popular mainly on account of religious or sentimental reasons. In view of the prevailing high prices of the concentrates and the value of the meal as a feed, it is high time that fish meal should be included in the food of the cattle setting aside the unfounded prejudices against its use.

Experiments in other countries have clearly proved that it is not the inclusion of the fish meal in the diet that gives rise to the fishy odour and the easy decomposition, but its administration in unlimited quantities. It is rather difficult to lay down hard and fast rules as to how much of fish meal can be administered to each kind of animal, as it depends on the other kinds of foods given. Fish meal as can be seen by analysis is a protein concentrate with a high percentage of minerals and so, for growing animals which are laying down new tissues, the maximum proportion of fish meal may be laid down as one pound per 110 lb. of body weight. It is neither economical nor good for the animals to be fed too great a proportion of fish meal in the diet or too much at any time. The amounts of fish meal that should be given to various animals normally are indicated below :

Cattle	..	2 lb. for every 1,000 lb. live weight.
Pigs	..	½ to ¼ lb. according to weight.
Sheep	..	1/10 to 1/5 lb. for 100 lb. live weight.
Poultry	..	Not more than 10 per cent of their whole food for adults and not more than 5 per cent for chicks.

These amounts vary considerably according as the other constituents (like maize, oat, potatoes, barley, etc.) of the diet contain higher percentage of protein or not.

The proportion of fish meal required decreases as the animal approaches maturity. The amount of fish meal must be decreased steadily until when the animal is chiefly laying on fat when it is no longer required. Its special use is as a tonic food and should be given for short periods every year though not continuously from year to year end.

Storage

The fish meal powder can be packed and stored in thick gunny bags or burlap bags in the cool season. If it is kept in a moist hot place or near boilers during shipping, it readily takes up the moisture and heat with the result that there will be break-down in proteins and consequent lowering of the food value. If it is not kept in a dry place, the humid air will cause it pick up fungus and worms and bacterial decomposition will set in.

Our packing the fish meal in four gallon tins up to the maximum capacity and soldering and keeping them in storage for several months has not shown any deterioration whatsoever. If empty tins are available the fish meal is best stored in them, closed and soldered.

Conclusions

The fish meal is very rich in proteins and minerals ranging from 60 to 80 per cent protein and 10 to 20 per cent of minerals on a moisture basis. The fish meal as prepared by us contain very little or negligible quantities of insolubles. The fish meal as prepared under ideal conditions and with the best of supervision and attention will naturally be a wholesome food to the cattle. It also contains certain elements essential for the well-being f animals and the protein and the minerals re in an easily assimilable form. In these ays of concentrated feeds, fish meal should ind a definite place in the list of stock feeds or cattle and poultry by virtue of its roperties.

Acknowledgments

Our thanks are due to Mr. O. S. Menon, B.A. Special Officer, Fish Manure Industry, Calicut for his valuable suggestions and constructive criticisms in bringing out this piece of work.

WAR EQUIPMENT HELPS IRRIGATION

IN the extensive irrigation areas of north-western Victoria there are hundreds of miles of open water channels, and keeping some of these channels clear of sand drift is a difficult and costly problem. Many efforts have been made to devise equipment for the purpose that would be efficient and economical, but with limited success.

Now the answer may be found by adapting and developing equipment used by the United States Army during the war. This latest instance of beating swords into ploughshares is largely fortuitous. During the war, the U.S. Army brought to Australia some 'Kellifer Ditchers' to plough long trenches for the laying of communications cables. Several of these super ploughs were advertised in connection with an Army Disposals sale. An officer of the Victorian State Rivers and Water Supply Commission noticed the advertisement, and was sent to the sale in Sydney to buy two of the Ditchers.

They are being used to excavate trenches for the laying of pipe-lines in the new irrigation area near Robinvale, in Victoria, and have proved so efficient that it is believed the design could be adapted and enlarged to handle the heavier work of clearing the open channels of the older irrigation areas. Development of a suitable design would save the Government thousands of pounds a year.—*Australian Agricultural Newsletter*, No. AGN/201.

ACTIVATED SLUDGE AS A MANURE

By S. DAS

IN India with its vast areas of land of low organic matter, the demand for organic manure is practically unlimited. Therefore, nitrogen conservation is of major importance for agriculture in India. With the growth of cities, the problem of dealing with the waste products of human life becomes increasingly difficult.

Water-carriage system

As the conditions of life become less simple, the water-carriage system, i.e. a system of underground pipes or sewers whereby waste matters are carried away from the houses, is generally introduced. Already in many Indian towns such a net-work of pipes and sewers exists, or provision is made to carry away the liquid waste by means of open channels. The liquid which flows along these channels consists mainly of wash water and urine and is known as 'sullage'. Solid excreta are generally removed by hand. But into a complete water-carriage system solid excreta may be discharged together with the same liquid waste which by itself constitutes 'sullage'. The liquid discharged from closed sewers and which includes solid excreta is known as 'sewage'. The problem of sewage purification deals with the conversion of these liquids and the impurities carried by them into inoffensive end products. The most modern processes, besides the purification of the sewage, aim also at the recovery of a large proportion of the nitrogen present for use in agriculture as a fertilizer. The sewage after oxidation is finally transformed into solid activated sludge which contains as a rule about 5 per cent of nitrogen, a considerable portion of which is easily available to plants. The effluent after purification in the above operations can be readily utilized for irrigation purposes.

Sewage farming

Numerous forms of plankton life, especially cyclops, thrive abundantly in the effluent. It is, therefore, expected that fish will live freely in the water. As for instance, fish are grown in a tank on the estate of the Government Rifle Factory at Ishapore near Calcutta, into which for some time the effluent from an activated sludge plant has been discharged. The fish have grown freely and thrive well under these conditions and are stated to be of excellent quality.

One of the first activated sludge plants established in India was at Jamshedpur, the town which has grown up round the Tata Iron and Steel Works. Here the sludge and effluent are used together to irrigate sugarcane. The resulting crop was three times that grown at Lucknow where raw sewage was used for irrigation. These results were confirmed with lucerne at Bangalore, thus showing the way to the production of excellent fodder for dairy farms.

Owing to the absence of colloidal matter in the effluent it can be stored in tanks without offence and used as required. In this way the fundamental difficulty associated with sewage farming, viz. either overdozing the land at times, or passing the sewage away untreated, does not arise. Such effluent ponds, if they contain a certain proportion of fresh water, can also support fish life.

The direct treatment of the sewage on land with the simultaneous growing of crops was the old method of sewage disposal for agriculture. This method is generally followed in India for the treatment of both sullage and sewage. This practice is however inefficient and wasteful. But the main difficulty in both sullage and sewage farms is that water and manure are required there at certain intervals only, whereas the streams of sullage and sewage flow continuously. In consequence, where strict supervision and sufficient hands are not available, the liquid is apt to run to waste, causing thereby considerable danger and nuisance, not to speak of the economic loss involved.

Experiments conducted at Poona, Lyallpur and Bangalore have shown that undiluted

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sullage or septic tank-effluent cannot long be treated direct on lands without clogging the pores of the latter and is also too concentrated for the healthy growth of crops. About three times dilution with irrigation water has, therefore, proved essential.

Procurement of such water may not be always possible. Further difficulty is that the soil is burdened with extra proportions of liquid. On the other hand, the effluent from the activated sludge process being free from colloidal matter does not tend to clog the soil, and contains less nitrogen than either raw sullage or raw septic tank effluent as shown in Table I.

TABLE I

Analysis of sewage and effluents

[G. J. Fowler (1934). An introduction to the biochemistry of nitrogen conservation, London, p. 198]

	Parts per 100,000	
	Ammoniacal nitrogen	Albuminoid nitrogen
Sewage	12·6	4·2
Septic tank-effluent ..	9·44	1·5
Activated sludge-effluent	Nil	0·06

Thus, the effluent from an activated sludge plant can serve for irrigating crops as diluted septic tank-effluent or sullage, but no process of sewage purification can remove the normal salt content of the effluent, which can only be effected by the periodical flushing of the land with clean water, unless this is done by rain.

The effluent from an activated sludge plant, if diverted from lands on this account, can be led into ponds where its nitrogen ultimately reappears in fish. The manuring of fish ponds with sewage has long been practised in China, and more recently at many centres in Europe. The use of raw sewage for this purpose is fraught with dangers and the fish is better kept in clean water for sometime in such cases before being utilized for human consumption. Where, however, the effluent from an activated sludge plant has been employed, this is found unnecessary.

Activated sludge as a source of nitrogen

The most labile forms of nitrogenous matter in the colloidal portions of the sewage are coagulated in the activated sludge process, as a result of which the activated sludge is richer in nitrogen content than the sludge from settling or septic tanks. The following data indicate the limits of different constituents in activated sludge obtained from different types of sewage.

TABLE II

Analysis of activated sludge

(Last three columns from A. J. Martin's *Activated Sludge Process*, p. 18, and the first column from the analysis of Mr. B. K. Das Gupta, I.A.R.I., New Delhi)

	I.A.R.I. New Delhi 1	Coimbatore 2	Jamshedpur 3	Bangalore 4	Shanghai 5	Washington 6	Manchester 7	Salford 8
Loss on ignition	46·77	64·1	72·5	..	..	70·4	64·7	54·5
Mineral matter	53·23	35·9	..	..	..	29·6	35·3	45·5
Sand and silica	36·74	14·4	..	..	..	..	..	..
Total nitrogen	4·12	5·88	8·88	3·33	6·00	6·0	4·6	3·95
P_2O_5	2·24	3·18	1·35	..	2·83	4·20	2·60	2·10
K_2O	0·95	0·67	0·25	0·88	..	..	..	..
CaO	2·87	7·63	..	..	..	..	..	..
MgO	2·20	..	..	..	..	..	..	..
Fe_2O_3	4·96	..	..	..	..	..	..	..

The sludge from sedimentation tanks or septic tanks hardly contains more than two to three per cent of nitrogen.

The value of activated sludge as a nitrogenous manure has been demonstrated in various parts of the world. E. E. De Turk (*Sewage Works Journal*, 1935) estimates that 40 to 50 per cent of nitrogen present in activated sludge is readily available for plant nutrition. Hadfield (*Bull.* 16, *Illinois State Water Survey*, 1918-19) reports that activated sludge gave as good results as other types of nitrogenous fertilizer with equivalent nitrogen. The activated sludge which had been acidified gave much better results than unacidified sludge. This is probably due to some hydrolysis taking place in drying the acidified sludge. Subrahmanyan and his co-workers obtained encouraging cropping results at Bangalore by using sewage as a source of nitrogen supply to the soil (*Proc. Nat. Inst. Sci.*, India **3**, 1937, 197-212 ; *J. Ind. Inst. Sci.* **15A**, 1932, 89-106).

Experiments in this laboratory have shown that depending on the nature of soils, 30 to 44 per cent of nitrogen contained in the quick-acting oilcakes like mustard cake undergoes nitrification in six to eight weeks and 26 to 34 per cent of nitrogen of activated sludge nitrifies in four to six weeks, whereas the rate of nitrification of other organic manures like compost, leaf mould and anaerobically fermented manure varies from 5 to 12 per cent only. The rate of nitrification of farmyard manure is very little in the first few weeks and much later on it begins to nitrify slowly. That is why the action of farmyard manure on soil fertility is rather a slow process, though in the long run it is very effective. It is thus found that the activated sludge has the second place with regard to nitrate availability next to oilcakes among the organic nitrogenous manures.

The results obtained with activated sludge at Jamshedpur, Bangalore and Lucknow have already been described.

The activated sludge plant at the Indian Agricultural Research Institute, New Delhi serves a population of 1,500 people. About 30,000 to 40,000 gallons of sewage are being treated daily and about 30,000 gallons of effluent pumped out daily from the well to the field. For these operations, there are two compressed air engines which run alternately for eight hours for continuous aeration of the tank, and two pumps for pumping out the effluent from the well to the field. Drying beds are used to dry the sludge.

The following average analytical figures will show that the effluent from this plant has never exceeded the standards set up by the Royal Commission on Sewage Disposal, namely, 3 parts per 100,000 of suspended matter and 2 parts per 100,000 of B.O.D. (Biological Oxygen Demand).

TABLE III

Eight months' average analysis of the effluent from April to November, 1937 *based on weekly estimations and expressed in parts per* 100,000

(From the analysis of Mr. B. K. Das Gupta, I.A.R.I., New Delhi)

	Total solids	Mineral matter	Suspended matter	Chloride as chlorine	Free and saline ammonia	Albuminoid ammonia	Nitrite	Nitrate	Oxygen absorption at 80°F		
									3 minutes	4 hours	At 65°F B.O.D.
April to November 1937 (8 months' average)	48·3	31·2	0·68	5·0	0·22	0·08	0·07	1·67	0·14	0·50	0·77
Sewage expressed in parts per 100,000											
April, 1937	..	..	..	11·2	12·50	5·00	..	..	4·10	11·06	..
May, 1937	..	..	..	6·6	6·25	1·79	..		1·90	5·03	..
June, 1937	..	..	..	7·0	6·25	1·39	..	..	1·26	5·38	

In 1936 an area of 9·47 acres near the sludge plant of this Institute was irrigated with sewage water. The sewage plots received raw sewage without treatment for five months from September, 1936 to January, 1937. It was only from February, 1937 that purified effluent and sludge were diverted to the plots, as the activated sludge plant started working in th last week of January, 1937. Oats and barle were grown in these plots in the cold weathe of 1936-37.

In the general area of this farm oats an barley were grown at the same time usin ammonium sulphate at 1 md. per acre as wel as niciphos at 1 cwt. per acre, which contains phosphates besides nitrogen. The comparative yields of oats and barley from these experiments are summarized in Table IV.

TABLE IV

Yields in md. per acre, 1936-37

(Data supplied by Mr. W. Sayer, I.A.R.I., New Delhi)

Crops from		Sewage area with activated sludge	General area	
			with Am_2SO_4	with niciphos
Oats	..	19·3	19·5	23·9
Barley	..	16·3	..	13·6

It is evident that both ammonium sulphate and activated sludge gave about the same yields of oats, whereas niciphos produced much higher yields. On the other hand, in the case of barley, activated sludge produced better yields than niciphos. Thus, the yields of oats and barley of the sewage area compared favourably with those of the general area manured with either ammonium sulphate or niciphos. The manurial constituents of the activated sludge used is given in Table II.

Some field experiments carried out at the Institute Farm with activated sludge are given in Table V.

TABLE V

Field experiments with activated sludge at I.A.R.I. Farm

(Data supplied by Mr. C. H. Parr, I.A.R.I., New Delhi)

Crop	Year of application	Plot No.	Plot size (acre)	Yields in md. per acre					Layout	Remarks
				Activated sludge	No manure	Standard error	Critical difference at 5 per cent level	No. of replications		
Barley I.P. 13.	1944-45	M. 5A	0·0497	33·6	24·7	1·41	4·5	4	Randomized blocks	Yields significantly higher than no manure
Wheat C. 518	1945-46	M. B. 5A	Do	29·8	24·4	0·78	2·4	4	Do	Do
Do	Do	M. B. 5B	Do	31·2	25·5	1·56	4·8	4	Do	Do

The foregoing cropping results indicate the high manurial value of activated sludge and the benefit to be derived from using effluent as irrigation water for crops.

Conclusion

G. J. Fowler in his *Wealth from Waste* states that a proper disposal of human excreta would realize Rs. 2 per head per year. Thus, 40 crores of the population of India should mean an annual gain of 80 crores of rupees to the country, if we would only make a wise use of human excreta. In India, the use of cattle manure is hampered by the frequent shortage of wood fuel which necessitates the burning of cow-dung instead of its return to the soil. Due to the prevailing high temperature of the tropical sun, organic matter applied to Indian soils is oxidized or burnt away in a short time. That is why it becomes necessary to take all possible measures to prevent wastage of organic matter and nitrogen along with it. This necessity leads to the conservation of nitrogenous manures in all forms available in the country. As shown above, the activated sludge will go a great way in meeting the major requirement of nitrogenous manure for Indian soils.

My thanks are due to Messrs. C. H. Parr and B. K. Das Gupta for supplying respectively cropping and analytical data of activated sludge.

ANJAN GRASS AT THE GOVERNMENT LIVESTOCK FARM, HISSAR*

THE Government Livestock Farm, Hissar, covers an area of 40,000 acres but only 5,000 acres of land is canal-irrigated. The rest carries a variety of natural grasses which grow entirely under natural conditions. In normal years of rainfall excellent grazing is available for livestock all the year round and in addition several stacks of hay are made to build up a very substantial fodder reserve.

Unfortunately from the years 1937-38 to 1941-42 continuous and unprecedented drought conditions prevailed. The average rainfall during these years was considerably below normal and was badly distributed. When this cycle of very lean years came to an end in 1942-43, it was discovered that very extensive bare patches, devoid of all vegetation had appeared all over the grazing area. Roughly speaking a total area of about 10,000 acres had completely caked up and it was apparent that unless suitable steps were taken it was likely to remain unproductive.

Permanent pasture

The Farm maintains about 10,000 heads of stock. The canal-grown fodder, due to short water supply contributed a very small percentage of the feeds required by the stock. The index of the Farm's prosperity is the quality of its permanent pastures. Here 'finance is grass and grass is finance'. The cheapest food for stock is grass. About 75 per cent, if not more, of all our feeding stuffs is grass in its different stages of growth. If the pastures are well-managed, they will actually become self-supporting and will be able to produce more stock for the country than they are doing at present. This famous Institute makes the most use of grass throughout the year. Its pastures are composed of species with flesh and milk-producing properties; special mention may be made of the *anjan* grass which grows extensively and produces all the needs of young animals, the minerals for bones and foodstuffs for flesh and fat.

All this grass land had so far been given to permanent pastures. Prior to 1937, when Rs. 78,000 in ten yearly instalments of Rs. 7,800 was sanctioned for anti-erosion *watbandi* schemes, the whole of the area was very severely ransacked by water and wind erosion. Much has been done towards controlling of water erosion by erecting suitable bunds which have considerably checked the flow of water to the natural depressions in the Farm land. In these burrows, by the side of the bunds, lines of over a lakh of *kikar* (*Accacia arabica*) trees have since been planted and these have gone a long way to affording wind-breaks, thus diminishing the atrocities of wind erosion.

Continuous droughts have aggravated the situation so much so that in addition to the appearance of bare patches the permanent grass has become weedy so as to look like root-bound sward, which starts slowly with rains and finishes early in autumn. It has become in a considerable area a mere relic of a good pasture. Continuous hard and close grazing has weakened the root system and adversely affected the drought-resistance powers of the plants.

The Farm land as a whole constitutes of light soils, with an exception of very small percentage of pioneer soils. With light land the problem is not so much of poor rainfall but high summer temperature and harsh drying winds. We get a much hotter sun and the temperature sometimes goes up to 119° F. This is really bad for our open light soil.

Lack of tillage

In the past we used to regard the grass in our pastures as something which 'just happened'. So far, our permanent pastures have been by nature 'sown to grass'. The output depends on the generosity of nature. The necessity of breaking up of the pastures from time to time and reseeding the same has been realized in all the stock-producing countries of the world. Permanent pasture has a low level of productivity compared with tillage land. Pastures are made productive by ploughing and reseeding. Tilth in heavy lands and moisture-holding capacity in the light land are the two great problems in pasture improvement. Dense and prolific grass is no more the outcome of an accident than any other crop. ‘ Grass crop follows the plough, giving its best where the rip of the plough has blazed the way ’.

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*Contributed by the Government Livestock Farm, Hissar.

Up to 1942-43 nothing had practically been done to plough and reseed the permanent pasture of the Farm which had been left to grass for over a century. The decreased productivity of the Farm pastures compelled us to find means of improvement. Direct tillage and reseeding of the ‘ spent portions ’ of the pastures to open up increased possibilities of growing grasses with less fibre and more protein became an acute problem at the Farm.

Experiments for reseeding

With a view, therefore, to developing practical methods, sufficiently low in cost to be economically feasible and capable of adoption at a large scale, for tilling and reseeding the bare patches, the following experiments were undertaken :

1. Three areas, typically rendered bare, were selected in the different parts of the grazing area and *kiaribandi* was carried out in them. The size of *kiaris* varied from one-fourth of an acre to two or three acres. It was hoped that the *kiaris* would retain the rain water and thus offer more favourable conditions for the germination of grass seed brought by wind. In spite of excellent rains in 1942-43 (over 25 inches), the *kiaribandi* plots were no better than the control plots maintained without *kiaribandi*, side by side with the experimental plots.

2. Twelve five-acre plots were selected in the centre of bare patches situated in different parts of the grazing area. Each of these five-acre plots was ploughed up with a country plough, and the ploughed-up area was enclosed by a *wat* or bund one foot high. The central one-acre area in these plots was then sown during the rains with *anjan* (*Pennisetum cenchroides*) and *palwa* (*Andropogon peritusus*) grass seeds, the commonest types found in the grazing area. These one-acre plots were then enclosed by thorn-fencing to avoid damage by cattle and were also bunded.

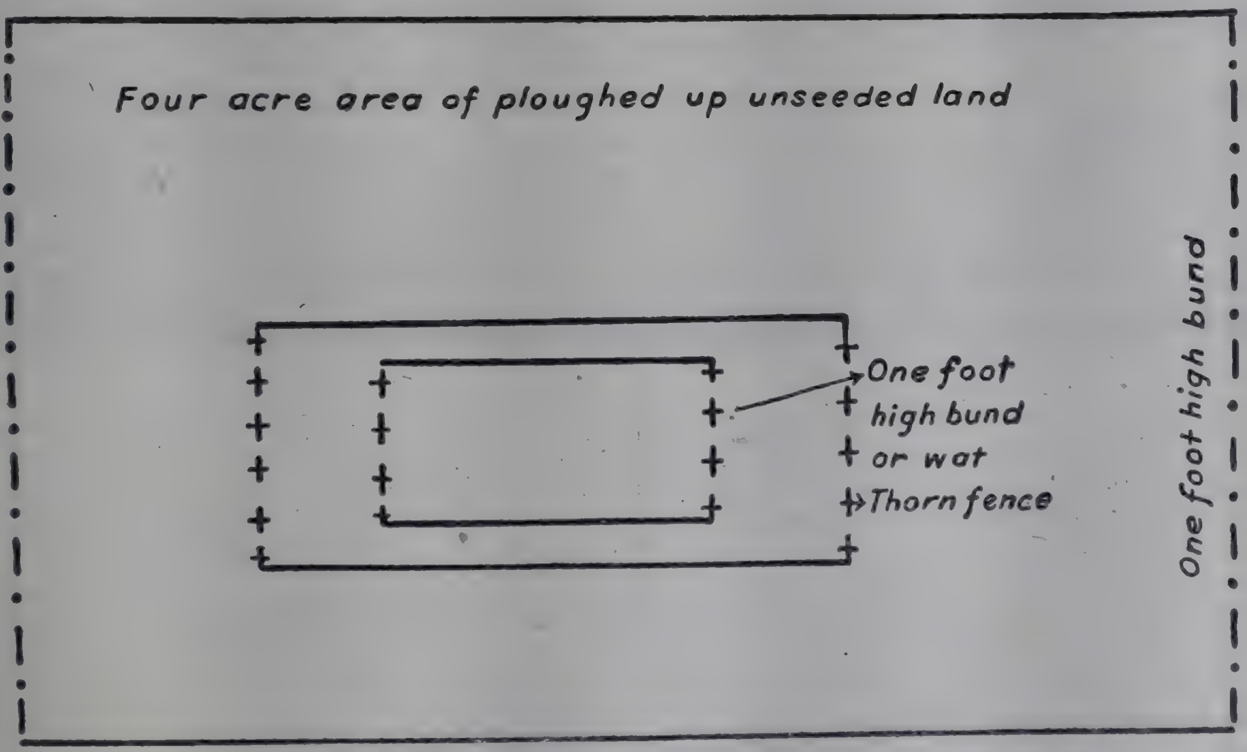
Four acre area of ploughed up unseeded land
One foot high bund or wat
Thorn fence
One foot high bund

Fig. 1. Ploughed-up land enclosed by *wats*.

There were excellent rains in 1942-43. The *palwa* seed did not germinate but *anjan* did very well. Not only was there a luxuriant growth of this grass and other weeds in the central one-acre area, but the surrounding 4-acre areas had also a good germination, which in the succeeding years got completely covered up. This was in distinct contrast with the bare land all around the 5-acre plots.

3. An area of 28 acres with very indifferent grass cover was divided up into 28 one-acre plots, each measuring 92 ft. × 462 ft. All except the control plots were cultivated with a country plough, spring-toothed harrow and cultivator separately. The cultivator was drawn behind a Fordson Tractor.

The four treatments mentioned above were each replicated seven times and were arranged in two blocks of 14 plots each.

Results

During the summer rains of 1941, various grasses and weeds appeared in these plots. The growth and the number of plants were studied in them. It was found that the best growth was to be seen in the plots cultivated with the country plough. In 1942-43 the growth in the plots where country-ploughs had been working was the best. Table I shows the outturn from the differently treated plots when harvested in January 1943.

TABLE I

Comparative outturn of the different cultural plots during the year 1942-43 : *Total produce of seven one-acre plots in each case*

Country plough				Control plots				Harrow				Cultivator			
Grass hay		Dry weeds		Grass hay		Dry weeds		Grass hay		Dry weeds		Grass hay		Dry weeds	
Md.	Sr.	Md.	Sr.	Md.	Sr.	Md.	Sr.	Md.	Sr.	Md.	Sr.	Md.	Sr.	Md.	Sr.
123	26	5	37	47	14	9	11	63	39	11	14	72	35	26	2
Total	129-23			56-25				75-13				98-37			

As apparent from the above results the country-ploughed plots produced the highest quantities of hay and decreased the natural weeds also. It shows the importance of the plough in regenerating the spent up pastures.

Experience gained as a result of the above-noted observations was put into practice immediately. So far about 500 acres of land in bare patches has been ploughed up and reseeded after enclosing it with small bunds. About 1,000 acres of land by the boundary of the Farm, which had been caked up, was let out on *batai* to the tenants. Simple ploughing up of these plots by the tenants has improved the grass cover to a great extent. Out of the 1,000 acres mentioned above about 500 acres have been sub-divided into plots of six acres each enclosed by *wats* of about 5 ft. bottom width by *watbandi* as follows :

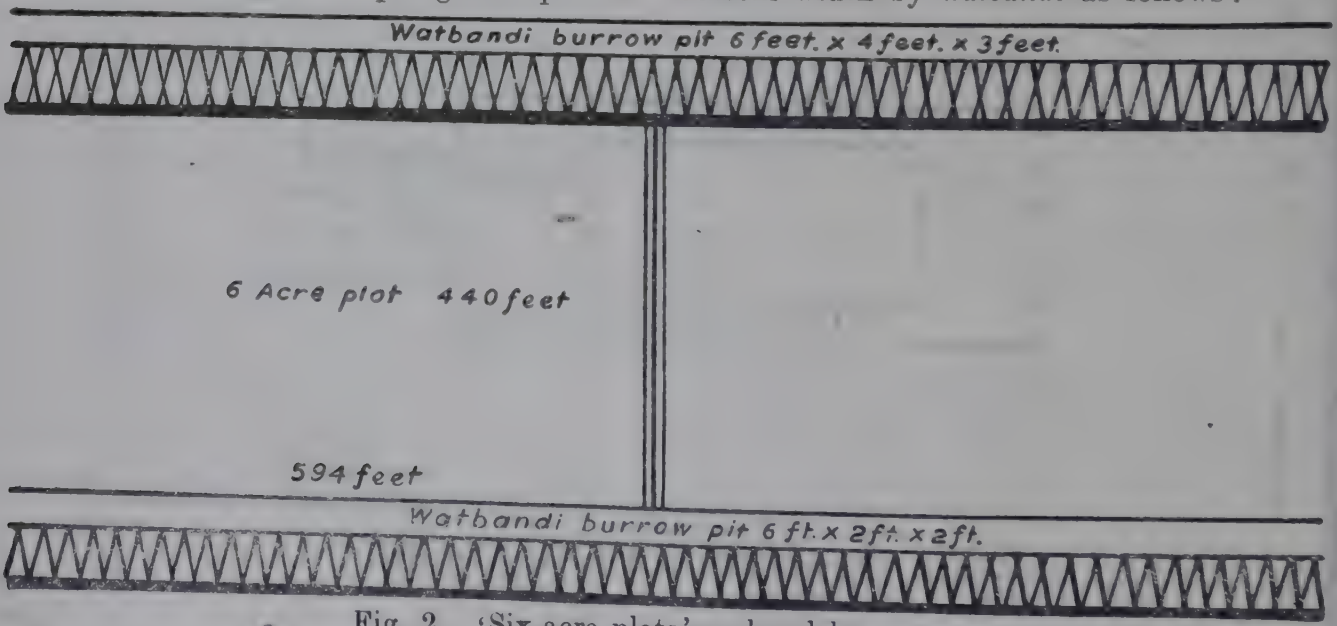
Watbandi burrow pit 6 feet. x 4 feet. x 3 feet.
6 Acre plot 440 feet
594 feet
Watbandi burrow pit 6 ft. x 2 ft. x 2 ft.

Fig. 2. 'Six-acre plots' enclosed by *wats*.

Sowing by tenants was carried by drills thus leaving open furrows. As a result of these operations there is a much better plant cover in this area, and incidentally a handsome quantity of grain and fodder comes in when there is a good rainfall. The open furrows catch the grass seeds which germinate in the rains. These plots have very much improved in vegetation, most of which is *anjan* grass.

Kiaribandi in itself does not offer a solution for the reclamation of bare patches in *barani* grass lands. It, however, does stop water erosion and help in improving the growth of whatever foliage is present in the land.

Bare patches in the *barani* grazing area can be made to grow grass again if they are ploughed up and reseeded, naturally or artificially, as shown in the case of the five-acre plots mentioned above.

Cultivation by harrow or tractor cultivator improves the land for grass production but better results are obtained by deeper cultivation such as achieved by the use of a country plough or a furrow-turning plough. The method employed is very cheap and within the means of the ordinary cultivator. The expenditure on the pre-war rates would be :

Ploughing charges for five acres ..	Rs.	10
Fencing of central one acre ..	Rs.	15
Total ..	Rs.	25

Bunding or ridging in this case is done by a furrow-turning plough.

The zamindars' *Shamilat Deh*, common grazing grounds, can be considerably improved by giving out lands for *barani* crops for one year after every third or fourth year. Reseeding can also be practised by broadcasting grass seeds on the lands given out for temporary cultivation at the time of sowing.

Ley farming is replacing permanent pastures all over the world. Grass lands are kept under grass for a duration of approximately three to four years only and are managed in such a way that they produce the maximum grass nutrients per season. It is ensured that when the date due for ploughing out has come round, the lands will be at the crest of their potency as regards soil fertility and its maintenance. The ley is ploughed when it is still at its best. Frequent use of plough in the grass lands will go a long way in improving the 'dead' grass pastures as found in our country.

Botanical description of anjan *grass*

Anjan or *dhaman* (*Pennisetum cenchroides*) is best suited for introduction in the permanent pastures specially where the lands are of lighter type. *Anjan* is also known variously as *karkan charwa* in Aligarh, *bandri* in Allahabad, *baiha* in Bundhelkhand, *kusa* in Rajputana and *bharbunt* in Jaipur.

The grass is perennial, tufted, with many stems, herbaceous, often decumbent, or bent or ascending, becoming much elongated when growing among bushes ; leaves narrow linear, acuminate ; sheath, smooth or hairy ; spikes cylindrical, dense ; rachis rough; flowers usually raddish-violet, rarely white ; skekelets in pairs, rarely solitary.

The analysis of *dhaman* or *anjan* grass reveals the following composition.

Dry matter	Ash	Fat	Crude fibre	Protein
100·00	9·60	0·97	27·46	5·13

Soluble carbohydrates	Insoluble residue	Iron (Fe_2O_3)
56·84	4·552	0·1350

Aluminium	(Alo)	Calcium	Magnesium	Sodium
0·453	23	0·626	0·0231	0·914

Potassium (K_2O)	Phosphates (P_2O_5)	Sulphates
1·257	0·410	1·764

High grade magnificent breed of cattle in the Hariana tract is due to the abundance of this grass. It provides to the animals a nutritious feed rich in soluble carbohydrates which are extremely useful for working animals and fattening stock. As the analysis shows it is rich in phosphates, sodium, iron and calcium which are very useful for the development of strong bone. A combination with *bur* grass (*Andropogon lanninger*), which contains calcium 1·040, potassium (1·648), phosphates (0·343), and sulphates (1·593) and is found in abundance in this tract, accounts for the magnificent build and outstanding feature of the Hariana cattle. This is undoubtedly the most nutritive grass which grows abundantly under *barani* conditions. It is a thick, juicy pale green grass and grows to considerable heights in favourable years.

Anjan grass grows in rich light soils where there is an abundance of moisture but the water does not stagnate. The most wonderful point about this grass is that its roots can live in the soil for years. About $\frac{3}{4}$ in. of rainfall in any part of the year help it in sprouting. It grows to its full heights during the rains and its seeds are ready by the end of September.

Attempts have been made by different dairy farmers in the Punjab to grow it in paddocks, but under irrigated conditions it cannot compete with *dab* (*Cynodon dactylon*) which ousts it after some time.

It can be grown by broadcasting the seed at the rate of five seers per acre in a well-prepared friable soil by the beginning of rainy season followed by light harrowing. It can be stacked for 14 to 15 years or even longer time if kept dry. If the grass is stacked when fully matured most of its seeds fall off; therefore, it should be harvested when the seed is in its milky stage.

It can be successfully ensiled in pits or stack silos. In a mixture of grasses its ensilage makes the other inferior grasses also palatable.

NEW SUGAR INSTITUTE

THE necessary preliminary steps to establish an Institute of Sugar Technology and Sugarcane Research, which may be the largest of its kind in Asia, were decided at a meeting of the *Ad Hoc* Advisory Sub-Committee of the Indian Central Sugarcane Committee held at Lucknow on August 26. Sir Datar Singh, President of the Indian Central Sugarcane Committee, was in the chair. The site selected for the Institute is Bhadruk Farm, about five miles from Lucknow.

The Sub-Committee decided that Bhadruk Farm should be taken over and the United Provinces Government allowed necessary facilities to vacate it. The Farm which has some building on it has an area of 553 acres. It used to be a military grass and dairy farm which was taken over in 1947-48 for the proposed Institute by the Indian Central Sugarcane Committee. The Farm was handed over temporarily to the United Provinces Government who wanted to utilize it for their 'grow more food' campaign and dairy development schemes.—*Food Bulletin*, August 30, 1948.

PRODUCE MORE EGGS

By C. G. GODFREY

SIR Frank Ware in his article on the 'Insoluble Problem'[1] has suggested that besides milk as a source of animal protein, two of the most obvious substitutes are eggs and fish and if the development of the poultry and fish industries were actively pursued and those who have no scruples about eating eggs and fish are encouraged to eat more of these foods, then a larger quantity of milk would be released to those who do not eat eggs and fish. No statement could be truer.

Need for reorganizing poultry industry

There is no doubt that the poultry industry in India is badly neglected. It is needless to mention that eggs occupy a unique place in the human dietary in providing protein as well as certain minerals and vitamins. Poultry farming should occupy an important place in a well-balanced agricultural concern, and next to dairy produce and cattle, it should rank third in importance.

It is perhaps easy to say that poultry farming should rank third in importance in agriculture. If, however, it is to be accepted that the 'present egg supply is to be multiplied even five-fold and if the foraging village hen is to be used as far as possible in doing it, something over four million tons of cereals will be needed in the way of poultry food,'[2] then this will mean an impossible drain on the cereal requirements of the country.

If we are to fall back on the foraging village hen to produce eggs as a possible substitute for milk, we are asking a lot. These birds are not capable of producing more than about 50 to 60 'pigeon' eggs a year, and with their present egg-producing ability are hardly worth their feed and keep. In pursuing the development of the poultry industry something much more is needed. Feed is the most important factor in producing eggs, and the average number of eggs produced by each bird determines the income to the owner. There is, therefore, a correlation between feed and the egg. A bird has the capacity to produce a fixed number of eggs, all factors being equal, and if a bird is given the right type and the right amount of food, there is every chance that the bird will produce its maximum number of eggs. The inherent producing ability of a village fowl is limited, and if the poultry industry is to be pursued on these lines, it is not likely to succeed. It will be years before the present country fowl is bred up to possess the characters of commercial importance as improvement in this direction can only be done by careful selection and breeding. It is, therefore, necessary to look further afield in order that more eggs should be available for consumption by those who have no scruples about eating them.

There are perhaps two methods of increasing egg-production, viz. either by the private owner who may possess a dozen or so fowls, or by the enterprising industrialist who has the capital to establish a commercial poultry farm. In both cases reliance should not be placed on the village hen. Whichever method is adopted, it is advisable that the pure-bred European fowls should be acquired. This is the only real solution in solving the immediate problem of obtaining one of the suitable substitutes for milk. Such birds are obtainable in the country.

Egg-production is the simplest branch of poultry-farming and is the most profitable. There is nothing more appealing than a regular income. There is always a demand for eggs

COL. C. G. GODFREY is on the staff of the Remounts, Veterinary and Farms Directorate, Quartermaster General's Branch, Army Headquarters, India and a preference is always given to the best and freshest eggs. To obtain eggs is not merely the keeping of hens and feeding them with whatever is available; it is something more. It is the skill of applying the principles of the science and art into practice. It is therefore advisable, however small a flock may be, that the poultry-keeper acquires a knowledge of the principles, facts, and natural laws underlying the successful management of poultry. Without a knowledge of the science and art, the industry however small will fail, and the birds will lose their ability to lay a large number of eggs and the eggs will get small.

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[1] *Indian Farming*, Vol, VII, No. 11, November, 1946, pp. 509-511.

[2] *Indian Farming*, Vol. VII, No. 11, November, 1946, p. 507.

With the domestic poultry-keeper, who may possess only a few fowls as a hobby to provide his own requirements and possibly to make a small income, the economic factors to be considered in egg-production are not so important. With the commercial industrialists, however, it is absolutely necessary that the economic factor be given every consideration. This is discussed below.

The capital outlay

The capital outlay varies greatly with the size of the farm it is proposed to establish. The main factor is the land. If the land is available free—well and good, but if land is to be purchased, the price may be prohibitive. Any type of land will not do. It must be in good condition, free from water-logging, and large enough to ensure that a part of it can be rested each year, otherwise diseases are bound to occur and failure will result. The next possible item in the outlay is the construction of suitable houses for the birds. These should not be elaborate but of suitable construction to meet requirements without having to incur heavy expenditure in periodical repairs. It is considered that the cost of laying houses might take up about 25 per cent of the total outlay. There is not a hard and fast rule and prices will depend on local conditions and availability of the material. After houses come the equipment. This is important as cheap inefficient material will cause no end of trouble. It is better to spend a little more so as to ensure that the farm is started on an efficient footing.

Running and recurring expenditure

In the capital outlay, no mention has been made of the cost of birds. Initially this may be a capital outlay, but as it is also a recurring expenditure it has been considered here. A farm can be started by the owner building it up from the egg. This is cheaper than resorting to the purchase of grown-up stock. It however takes time. For the impatient beginner a small foundation flock may be purchased from which eggs can be incubated, hatched and the chicks reared. This is possibly a good method as the beginner will gain experience. In ignoring the initial capital outlay on acquiring stock, the most important single item of expenditure under this heading is the cost of feed. So heavy is this item that every care must be taken to ensure that no wastage occurs. It is false economy to go in for poor feeding stuffs or the wrong kind of feed. This point cannot be too strongly emphasized. It is also false economy to feed less than the accepted amount of ration. Good and correct feeding is one of the main maxims for success. The next and very important factor is the cost of labour. Insufficient labour will cause failures. Retain what is sufficient and pay well to ensure that you have good men. Employ men who have a natural love for the birds as the observations they make, particularly in detecting birds that are ill or off-colour, will go a long way to ensuring success. The next item in the balance sheet is to include cost of electricity, water, depreciation on your capital stock, and cost of any poultry purchased.

The above concludes in a very general field what expenditure is incurred. The next consideration is the income.

Egg-production

This is the most profitable source of income, and offsets the very heavy charges in feed and labour. The guiding principle in this item is the minimum number of eggs that should be obtained each year from each bird, so as to cover all items of expenditure, and leave a margin of profit. This minimum figure for India is probably an average of 140 eggs per bird per year. Anything below this figure will mean a loss, and the higher the production over this figure the greater the profits. Satisfactory production rate will depend on the quality of the bird, the feeding of a properly balanced diet and first class management—the latter greatly reduces the incidence of diseases. It is also to be realized that each year a hen is kept for egg-production, it lays about 20 per cent less each year. A bird that lays 140 eggs the first year will probably lay, all things being equal, about 112 eggs the next year, and 100 eggs the year after that and so on. The question of having a large number of laying pullets in the flock must therefore be considered.

Out of season production

Hens are very badly affected by the heat, with the result that the period of the greatest scarcity of eggs in India is during the hot weather. At this time of the year, eggs command a higher price, and it is as well to try and ensure that production is carried over the hottest periods. To do this is an art. Chicks hatched in October come into lay about April/May. During the cold weather they have a good opportunity of attaining maturity, that is a steady progressive growth rate unhindered by setbacks caused by the hot weather. When they are about to lay they come up against the hot winds and temperatures experienced during the initial egg-producing ages. At this time it is essential that management is high and that the birds are ensured every comfort. Over-heating foods must be avoided and palatable foods should be given, as it is the amount of food a bird eats that ensures the maximum egg-production. In order, however, to balance egg-production throughout the year, a proportion of the birds should be hatched at other periods. Do not hatch too late in the spring as birds cannot be expected to lay if reared during the hot weather. Good egg-production depends on good growth rate and a good climate is necessary for this.

Diseases and deaths

Every casualty means a potential loss of income. Each egg laid should be looked upon as being equivalent to five times the value of the market price of an egg. This is obvious when hatchings are done for replacement, as every chick hatched costs about five times the value of an egg. The fact that diseases and deaths mean a loss of income must not be overlooked. For every ten per cent of loss by death amongst the laying stock means a double loss in income. Amongst chicks up to eight weeks, the mortality figure must not exceed 15 per cent, and for other birds 5 per cent.

The correct use of labour

Getting the best out of labour depends largely on the set up of the farm. The management of a poultry farm depends a lot on the workability of the farm. Poultry houses should be arranged in such a way as to ensure easy working. Another factor that might call for attention is the number of birds allotted to each man. It is false economy to expect one man to look after too many birds and *vice versa* if a man is given too few birds. As a general guide it is considered that one man could look after 1,500 laying birds, and another man could manage 800 chicks up to the age of six weeks. Eight hundred chicks is a small number but baby chicks require constant attention, especially on cold nights when drafts may cause an awful lot of trouble.

Plan to maximize egg-production

Having dealt briefly with the economic factors in egg-production, it is well to discuss how a plan might be implemented to produce the maximum eggs at a time when eggs command the highest price, that is, during the hot weather.

The basis of the plan is the size of the farm. In this case, it will be assumed that the farm consists of 1,000 laying birds, and that there are 20 laying houses, each house being in its own pen area measuring about 120 ft. × 90 ft. The primary object in implementing the plan is to ensure that there is no overcrowding, and that half of the pens and houses are rested for eight months after every 16 months. This 'resting' is done during the hot weather.

It will also be necessary to rear laying hen replacements by regulated hatchings. These hatchings are made just before the cold weather so that the birds come into lay just before the hot weather. The basis of calculation is the hatching of 2½ chicks for every laying bird to be replaced. This means for replacing 1,000 laying birds, 2,500 chicks are required to be hatched. To house 2,500 chicks, 13 brooders rooms, each measuring approximately 12 ft. × 12 ft. are required. Each brooder room is to contain two brooders and each brooder holding up to 100 chicks.

It is necessary to explain why a basis of 2½ chicks per hen has been taken. For replacing 1,000 laying birds, 2,500 chicks must be hatched. Of the 2,500 chicks hatched, 500 or 20 per cent will be casualties. This leaves 2,000. Of this number half will be males and half females. The males are sold when 16 weeks of age which reduces the flock number to 1,000. When the chick at the age of eight weeks move into the pen houses, 200 will be allotted to each house, thus 10 of the 20 houses come into occupation. By the time these birds are 16 weeks of age, the size of the male birds will be suitable for marketing, when the number of pullets in each pen will be 100. The plan will therefore work as follows:

(a) *Duration the pens are occupied:* Once chicks have been transferred to pens (which have been vacant for eight months) they will remain in those pens for 16 months, i.e. until their usefulness as egg-layers ceases, when they can be sold.

(b) *Hatchings:* Hatching results are based on obtaining 60 per cent of chicks on all eggs set. If this figure is exceeded more vigorous culling can be done to reduce the number to 60 per cent.

(c) *Incubation:* On a fixed date each year, say on 9 September, hatchings should start. The first chicks to be drafted to brooders will therefore be on 1 October. To obtain 2,500 chicks, the settings in the incubator will therefore be as follows:

1st setting	9 September	550 eggs	To brooders	1 October	To pens	1 December
2nd ,,	16 ,, ..	550 ,,	,,	8 ,,	,,	8 ,,
3rd ,,	23 ,, ..	550 ,,	,,	15 ,,	,,	15 ,,
4th ,,	30 ,, ..	550 ,,	,,	22 ,,	,,	22 ,,
5th ,,	7 October ..	550 ,,	,,	29 ,,	,,	29 ,,
6th ,,	14 ,, ..	550 ,,	,,	5 November	,,	5 January
7th ,,	21 ,, ..	550 ,,	,,	12 ,,	,,	12 ,,
8th ,,	28 ,, ..	550 ,,	,,	19 ,,	,,	19 ,,
	Total	4,400 eggs or 2,640* chicks at 60 per cent				

* This figure can be accepted as 2,500 chicks.

(d) *Obtaining fertile eggs for incubation:* Under the above plan, pullets come into lay from about 1 April to about 19 May. They will go on laying for approximately 12 months. In the following year more eggs have to be set. It is as well, therefore, about one month before settings are due, to obtain good strain cocks and place them in pens of selected hens. The egg requirements are 550 eggs for each setting. For this purpose 20 cocks, i.e. 2 per cent of the flock is sufficient. If 15 selected hens are given to each cock, that is 300 hens giving fertile eggs, it will be easy to select 550 eggs each week from these 300 hens, since the minimum rate of production from 300 hens should at that time of the year be about 600 eggs a week.

To set 550 eggs each week for eight weeks will require three incubators of 550 egg-capacity, or double this number if the incubators are half the capacity. Fig. 1 shows the way to use the 20 laying houses for a 1,000 laying-bird farm.

SPRAYING FRUIT TREES

By P. L. RENJHEN

THE practice of spraying orchards to protect them from attacks of insect pests and plant diseases is sometimes viewed with suspicion by fruit-growers in this country. Some regard it as a positive evil while others take it as an essential part of commercial fruit production. To some it is a question of economics; others know from their experience that they cannot afford to neglect such an important seasonal operation in their orchards. It is only when a grower suffers a heavy loss that he begins to realize the necessity for spraying. Some growers, especially those who have their fruit gardens in isolated belts intervened by other crops, have never had any experience of severe attack by insect pests and plant diseases, but all the same they actually suffer a continuous annual loss from these diseases which they are unable to detect. With a little prudence even this loss can be avoided by spraying in large plantations or in districts where there are many orchards. Severe and epidemic attacks are almost sure to occur from time to time if trees are not sprayed. Spraying for an orchardist is an insurance against insect attack.

Use of spraying

Spraying should be considered as one of the most important orchard operations and should be included among the routine annual practices such as pruning and orchard sanitation. Orchard sanitation by which is meant the careful removal and burning of broken or diseased branches, ploughing in of fallen leaves, and removal and destruction of all maggotty and diseased fruits, will form a valuable supplement to spraying in keeping many pests and diseases under control. Spraying is undoubtedly a little expensive operation but a good deal of the annual loss due to insect pests and plant diseases can certainly be regained if this mode of operation is resorted to with a little prudence. The judicious selection of (1) the time of spraying, (2) the material to spray with and (3) the correct mode of spraying will all contribute to minimize the expenditure incurred in this operation.

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Time of spraying

Fruit plants mostly suffer from attacks of two types of organisms, viz. insects and fungi. The habits of these organisms and consequently the mode of destruction of the plants or parts thereof by these differ very widely. Further it is only certain definite stages of these organisms that cause harm to the plants. It is, therefore, necessary to know the right time of occurrence of these stages on the plant and spraying should be resorted to at such a time in order to achieve perfect control. Again spraying may be conducted as a preventive measure too. In this case, spraying is undertaken a little prior to the time when an insect pest is likely to lay eggs on the plants. The time of spraying is an important factor in achieving satisfactory results. By keeping a careful watch upon his tree all the year round, the grower should know exactly the stage of development of a pest at a particular time so that he may resort to proper remedial or preventive measures. Spraying should not be done in the middle of a very hot day. On a hot day spraying should be done during early morning or late in the afternoon.

How and what to spray

Spraying is one of the most complex operations as a successful spray is dependent upon many factors, viz. the appearance of fungus diseases, the life-histories of injurious insects, the operation of a spray pump, weather conditions, variations in susceptibility of fruit varieties to the pests, the selection of the proper spray materials, the management of spray crew, the convenience of water supply, etc.

The personnel should be trained in (1) the manipulation of the spraying rod and (2) the direction of movement of the rod and the consequent adjustment of the stopcock.

Foliage is easily bruised if the nozzle is held too long in one position or too close to the tree. It is of utmost importance to select the right kind of nozzle and adjust it to give the right kind of spray. On this depends not only the quality of work, but also speed with which it is done. The best kind of spray has ample length and ample breadth so that a good cover in a minimum of time with a minimum of wash can be obtained. It should be borne in mind that the size of the outlet limits the height to which an effective spray can be delivered and the pressure must be in relation to the size of the outlet. The pump and the nozzle should be large enough to avoid wastage of time and small enough to avoid wastage of material.

The spray must reach well above the trees. This is determined by the setting of the nozzle and the pressure used in working the pump. Arrangement for obtaining the supply of chemicals needed for spray should be made well in advance as it may not always be readily available. Empty coal-tar drums or big earthenware vessels (locally known as *chattis* or *matkas*) must be kept filled beforehand, at a convenient place in the orchard, to provide a sufficient reserve.

Right kind of spraying mixture, properly made and mixed may be applied. Insecticides and fungicides improperly made are even worse than useless and may do more harm than good to the trees. Every part of the tree—trunk, branches and leaves—should be completely sprayed with the spraying mixture. The uncovered patches left on the tree serve as means of attack and breeding place for the pest. In applying the dormant spray it is essential that the whole tree be covered with spray because this is a contact spray and must hit the insect in order to kill it. The spray from a nozzle should penetrate all parts of the tree and should not leave on the foliage any more moisture than is absolutely necessary to moisten it. If carried out without proper supervision, the mixture may prove injurious to vegetation, for there is some reason to suppose that the arsenical compounds washed down into the soil may, after a certain length of time, prove injurious to vegetation[1]. No definite estimate can be given of the amount of spray necessary as it varies with many factors, viz. size, density and variety of the tree and the pests or diseases to be controlled. Great care must be taken in handling the washes on account of their poisonous properties. The spraying machine should be thoroughly washed and cleaned after daily use. The spray to be used depends upon the nature of the insect or plant disease to be controlled and upon the weather conditions which prevail at the time of spraying. If the insect has sucking mouth parts, such as plant lice and San José Scale, a contact spray must be used. Contact spray contains caustic or other penetrating substances which penetrate the skin, corrode the tissues inside and thus cause death. The poison may also some time act in a different way. It may clog the spiracles and death is caused by suffocation. In the case of codling moth caterpillars and other insects with biting mouth parts, stomach poisons are used. The poison is sprayed on the leaf and when the insect or caterpillars eat the leaf, the poison causes inflammation of the alimentary canal and brings about the death of the insect.

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[1] Thompson, W. R. (1930). *The Biological Control of Insects and Plant Pests*, 29, 9.

What the Scientists are doing

COMPARATIVE STUDY OF HAY BOX METHOD IN *GHEE*-MAKING

HAY box method involves the use of a wooden box spacious enough to hold *kahrni* (earthen vessel for heating milk) packed firmly, but not tightly with *bhusa* leaving just enough space on top for holding the *kahrni*. The morning milk after being boiled is put in *kahrni* and transferred to hay box. More *bhusa* is packed into the box all round the *kahrni* up to level with the top. The *kahrni* is then covered with a wooden or a metal cap and covered with hay. The efficient thermal insulation in the box preserves the milk heat till the evening when the heated morning milk can be transferred to a *chatti* containing evening milk. This method has been suggested as a measure to save fuel while intending to keep milk in good condition. But there has been variance of opinion whether the quality of *ghee* or butter-milk prepared from the milk preserved by this method is better than that prepared by other methods, viz. creamery method or the indigenous method of simmering the milk all the day.

Some experiments have been carried out under the aegis of the Indian Council of Agricultural Research at the Indian Dairy Research Institute, Bangalore, Jhallar in the Central Provinces and Montogomery (now in Pakistan). The hay box method has been compared with other methods under identical and controlled conditions, with regard to the outturn and cost of production, storagability and quality.

It has been observed that hay box method is more economical than simmering method; it obviates acquiring of smoky flavour in the final product but its efficacy as a means to preserve milk in all seasons has not been proved. In this method as well as in the simmering method the present practice of adding evening's unprocessed milk takes away much of the benefit derivable from processing and sweet preservation of the morning milk. Such addition does not ensure the type of fermentation desired in the course of ripening of milk with lactic starter thus resulting in the production of poor quality butter and butter-milk.

With the creamery method there is best recovery of fat which is not affected by seasonal influences. Hay box method leads to better recovery than is obtained in the case of simmering process but the advantage is not very significant. Yield of *ghee* was higher in winter at Jhallar by simmering as well as by hay box method, than the yield in the rainy season. No seasonal influence was observed at Bangalore which may be due to even atmospheric temperature throughout the course of investigation. The cost of production of *ghee* is less with the creamery method, while in hay box method it is cheaper than *desi* method. The differences are insignificant as regards the quality of the *ghee* as determined by acidity, flavour and grain structure. Grain structure was, however, affected by season and not by the method of preparation.

All these observations conclusively prove that hay box method has no advantage over other methods as regards the quality or the amount of *ghee* prepared from the milk stored by this process. (H.K.L.)

You ask We answer

Enquiries regarding agriculture and animal hustandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. (1) What is the best method of laying down and improving grass in forests and arid areas ?
(2) Is there any chance of improving the nutritive value of wild grasses by breeding and management ?

A. (1) In dry zone forests and in arid areas at present bare but under afforestation the best method undoubtedly is contour trenching. Earlier work on afforestation and grass planting made use of short lengths of isolated trench usually 10 ft. × 1 ft. × 1 ft. but this allows much water to escape and is not so efficient as continuous trenching, or rather a continuous row of interrupted trenches 10 ft. long with a 2 ft. gap between each, and with the berm built continuously throughout each series of trenches on the contour.

(2) Neither breeding nor management o waste land as such is likely to effect any marked improvement in our wild grasses The crux of the matter lies in the time o ripening and harvesting. Most of our wild grasses ripen in September and are dry and useless nutritively by November onwards. We cannot persuade the cultivator to cut grass except when he has leisure from crops to do it; so the only alternative is to delay ripening by better water conservation. Contour trenching in even the most arid areas has a marked effec in this direction particularly when combined with tree growth; the shade of the trees plus the added moisture round the trenches gives an additional month or six weeks of green life so that even in December the grass is worth cutting. (R.M.G.)

What's doing in All-India

WEST BENGAL

P. S. MAJUMDAR

N the wake of partition, the new-born province of West Bengal had to face a host of problems relating to varied aspects of griculture. The bearing of such problems n her food position being of profound imporance, the attention of the newly-created Directorate of Agriculture was at once devoted mainly to such measures as were helpful in mproving that position.

Extension work

Partition gave West Bengal a very much larger staff for extension work than what she had when the province was undivided. This is because a large proportion of the officers employed in undivided Bengal opted for service in the new province. Many of these officers were previously posted in stations which went to East Bengal. They had to be moved to their new places. All this was achieved in about a month and the newly-born Directorate, with its new set up, was ready to play its role in the newly-born province by about the middle of September. According to this new set up, the province was divided into Ranges each in-charge of a Deputy Director of Agriculture, and all of them working under the Assistant Director of Agriculture. Each Range had four to five districts. A Superintendent of Agriculture was appointed for each district, a Sub-Divisional Agricultural Officer for each Sub-Division, a Thana Agricultural Assistant for each Thana, and a Union Agricultural Assistant for each union, i.e. a group of about 6 to 10 villages. For the first time, therefore, there became available an agricultural worker at the union level, which made it possible for the Directorate to establish close contact with the cultivators.

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Potato is a very important cash crop of West Bengal. She grows about 20 per cent of the total area of potato in India. But she depends upon external sources for a large part of her requirements of seed. Of these sources, Simla is the most important. On account of the disturbances prevailing in the Punjab, special arrangements had to be made to procure supplies from Simla. Moreover, because such supplies were very uncertain, steps had to be taken to conserve and rationally distribute the home supplies. This was the first duty of the new Directorate of Agriculture. Simultaneously, attention was also placed to the 'grow more food' activities such as supply of fertilizers, manures, compost, *rabi* seed, improved agricultural implements, iron and steel required by the cultivators. The quantity distributed in each case is shown below:

Bone meal—2,700 tons; Ammonium sulphate—6,000 tons; Ammonium phosphate—340 tons; Oilcakes—1,30,000 md.; Cowdung of *khatals* in Calcutta—5,500 md.; Village compost (worked in 630 centres)—6,500 tons; Town-compost (worked in 23 centres)—5,465 tons; Sewage sludge of Calcutta—1,000 tons; Improved ploughs—470; Planet Jr. hand hoe—85; Persian wheel—80; Iron and Steel —1,800 tons.

Extension of area of **boro** *paddy*

Nearly 25 miles from Calcutta, there is an area of 20,000 acres, which gets flooded during the rainy season. Nearly 12 years back, this area used to produce a beautiful crop of *aman* paddy, but has been lying almost waste since. With a view to demonstrate to the cultivators that the area could still grow paddy, but of a type different from the one they were used to, a scheme to demonstrate cultivation of *boro* and deep water paddy was launched. *Boro* paddy was successfully grown in an area of about 200 acres, while cultivation of deep-water paddy over an area of about 300 acres is now in hand. The cultivators, who have reaped their crop after a lapse of 12 years, have been amazed to see the achievement. If we are equally successful in case of deep-water paddy too, it can be hoped that the cultivation of these new types will extend to almost the whole of this area.

New food targets and schemes

The new province has been assigned the revised target of producing 4,00,000 tons of additional food per annum by 1951-52. Revised 'grow more food' schemes to achieve this target have been prepared.

The developmental programme, adopted for undivided Bengal, had to be revised in the light of the smaller territory, changed needs and objectives, and large number of staff, etc. in the new province. Revised schemes have been, or are being, prepared.

Research work

The province of undivided Bengal had its Central Agricultural Research Laboratories at Dacca, which fell in the share of East Bengal. The agricultural research activities in the undivided Bengal were, therefore, naturally centralized at Dacca. But with the partition, the new province had to face the unhappy position that, while she had at her hands a large number of research personnel comprising of persons who were previously employed at Dacca and had since opted for West Bengal, she had no suitable laboratories or equipments to accommodate such personnel. Accommodation had, therefore, to be improvised for them at a number of different places. This was by no means a happy solution, but it was all that could be possible until permanent laboratories could be constructed.

The staff have now settled down under their new environments and taken to their work. The task of evolution of new varieties suited to the varied conditions of this province, which was rather neglected heretofore, has been taken up. A 150-acre potato farm has been established at Rungbull in the district of Darjeeling for the production of comparatively disease-free potato seed. It is hoped to raise nearly 7,500 md. of such seed this season, which will be further multiplied in the plains through the agency of registered growers.

MYSORE

M. L. N. IYENGAR

MYSORE has always been famous for its *gur* and sugar. A century ago, in 1848, sugar was being manufactured from *gur* at the Ashtagram Sugar Works at Palahalli near Seringapatam. This sugar won the prize and medal for the best crystallized sugar in the Empire at the Great Exhibitions in London in 1851 and 1861 and met with great appreciation at the Universal Exhibition in Paris in 1867. Due to various causes this industry languished and died out.

Sugar industry

About 15 years ago, before the Mysore Sugar Factory at Mandya was established in 1933, the State was importing annually about 9,000 tons of sugar, valued at Rs. 30 lakhs. When the life-giving waters of the Cauvery[1] were harnessed at Krishnarajasagar and brought to the dry thirsty soils of the Mandya District by what is known as the Irwin Canal[2], the Government simultaneously took measures to develop the agricultural wealth of this backward area by establishing a sugar factory and providing it with two-thirds of its capital. This experiment in 'State Socialism' has borne rich fruits. The State is now not only self-sufficient in regard to her sugar needs but also

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[1] The Cauvery is rightly regarded as the mother of all wealth in Mysore. The river not only irrigates over 2 lakhs of acres in Mysore territory but also provides power for all her industries, gold mines, Iron and Steel Works, fertilizer and textile factories.

[2] There is a proposal to rename this Canal as Visweswara Canal after Mysore's famous Engineer-Statesman, Sir M. Visweswaraya, to whose vision the Canal, in a great measure, owes its existence.

has a tidy exportable surplus. In 1940-41, seven years after starting the factory, the State exported 22,024 tons of sugar valued at Rs. 69 lakhs.

The factory at Mandya is one of the biggest sugar units with a crushing capacity of 2,000 tons of cane per day and a production capacity of 30,000 tons of sugar per annum. During 1946-47 the factory crushed 1,57,787 tons of cane and produced 16,058 tons of fine quality sugar. The recovery percentage is fairly high on account of the high quality of the Mysore cane and is steadily increasing. It was 9·86 in 1933-34 and 10·85 in 1945-46. On account of inadequate supplies of cane the number of crushing days in 1946-47 was only 182 against 232 the previous year and 335 in 1937-38. Besides paying an excise duty of over Rs. 10 lakhs, the factory made a profit of Rs. 6 lakhs. The reserve fund now stands at Rs. 46,73,825 against a paid up capital of Rs. 20 lakhs.

Another factory will shortly be established at Shimoga. A joint-stock company with an authorized capital of Rs. 5 lakhs is to be shortly floated. In accordance with their usual policy in such matters, the State Government is taking 55 per cent of the shares and has nominated a few Government Directors to the Provisional Board. The factory will have a crushing capacity of 800 to 1,000 tons of cane per day and an annual production of 10,000 to 12,000 tons of sugar.

A third factory in Mysore District is being considered by the District Board. There is also a move to open a fourth one in Goribidanur in Kolar District. When these programmes and plans materialize, Mysore may well become one of the biggest sugar-producing and exporting areas in India.

Mysore Horticultural Society

On account of its situation in the tropics and its general elevation of over 2,000 ft., the Mysore plateau has a climate which is particularly suitable for a large variety of crops—agricultural and horticultural, tropical and temperate. From a long time both the people and its rulers have evinced considerable interest in the introduction, acclimatization and propagation of new crops. The Lalbagh at Bangalore, which is well-known for its large collection of economic and ornamental plants, was laid by Hyder Ali. Tippoo developed it and started similar gardens elsewhere[3]. Later, the Lalbagh passed under the hands of the East India Company and was for some time maintained from Imperial funds.

As early as 1836 Sir Mark Cubbon started a Horticultural Society but it had only a very short existence and did not survive beyond 1842.

The present Horticultural Society was started in 1912. It is affiliated to the Royal Horticultural Society of England. Its membership according to the latest report is 244 and it has an annual income of nearly Rs.10,000. The members are privileged to receive free supply of plants and seed to the full amount of their subscription, assistance in combating pests and diseases for which a special organization has been built up and free inspection of gardens and advice.

Two horticultural shows are arranged every year, one in August and the other in February. As this year's winter show was held on 13 and 14 February under the shadow of the great calamity that overtook the country on January 30, the response was not so good. But the quality of the exhibits was maintained. His Highness the Maharaja's cup (for annual flowers) was awarded to Mrs. B. G. Harris. Mr. K. S. Gopalaswami Iyengar's new Bougainvillea—'B. Mahatma Gandhi'—attracted a large number of visitors. There were nearly 300 prizes for foliage plants, perennials, fruits and vegetables.

Mysore Agricultural and Experimental Union

The Mysore Agricultural and Experimental Union is in many ways a unique organization. It was founded in 1918 by Dr L. C. Coleman, the first Director of Agriculture, as a union of farmers and professional men for the purpose of conducting combined agricultural experiments. The Union celebrated its Silver Jubilee in 1944 and is growing from strength to strength rapidly. Its membership now exceeds 4,000 and it publishes two agricultural journals, one in English every quarter and the other in Kannada every month. The Kannada edition has perhaps the largest circulation among agricultural journals in Indian languages. It has several branches all over the State, in districts, taluks and *hoblis*.

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[3] Tippoo was responsible for a number of plant introductions. The soft sugarcane of Mysore known as Local Stripe or Pattapatti was, it is learnt, brought by one of Tippoo's officers from Mauritius. Tippoo also introduced fig cultivation in Ganjam, a few miles east of his Capital, Seringapatam.

The annual meeting came off on April 4, 1948 at Hessarghatta and adopted a new constitution for the Union and elected a new executive body. It was presided over by the Minister for Public Works and Agriculture.

Mahatma Gandhi Hydro-electric Project

Mysore State was the first to establish a Hydro-electric Station in India as far back as 1900. There are now three power stations at Sivasamudram (capacity 42,000 K.W.), Shimoga (17,000 K.W.) and at Jog (ultimate capacity 120,000 K.W.). The first stage of the Jog Project which is now named after Mahatma Gandhi has just been completed and the power was switched on by His Highness the Maharaja of Mysore on 21 February, 1948.

All the nine district headquarters and many of the taluk headquarters have been provided with electricity. The number of consumers today is over 65,000 and the *per capita* consumption is 31 units, which is the highest in India. One thousand twenty-one irrigation pumps in the State are worked by electricity. It is the ambition of the State Government and the ruler that every village in the State should receive the blessings of electricity. So far only 230 villages out of a total of 18,000 have these benefits. It is already being felt that the power generated in the three projects is inadequate to meet the growing demands and new projects at Mekedatu or 'Goat's Leap' where the Cauvery leaves the Mysore plateau through a small ravine to the Madras territory, at Lakkavalli where a combined irrigation and electricity scheme is in operation and at Jog itself for production of another 120,000 K.W., are being programmed. When these plans are executed, cheap power may become available to the ryots all over the State.

Legislation

Two bills of some importance to cultivators were passed at the January Sessions of the State Legislature.

Under the five-year post-war schemes, it is programmed to restore about 10,000 minor tanks at the rate of 500 a year. On account of the steep rise in the cost of materials and labour, this programme was getting slowed down. To speed up this essential work, the Minor Tank Restoration (Amendment) Bill enabling the Government to recover part of the cost (about 1/4th) from the ryots who are benefited by this restoration, was passed.

The second bill concerning cooperative societies is a comprehensive amending and consolidating measure to give effect to the recommendations of the Committee on cooperation that reported some years ago under the Chairmanship of Rajadharmapravina Dewan Bahadur K. S. Chandrasekhara Iyer. In addition to re-enacting the provisions of the existing law, important changes in regard to liability, period of limitation, mode of recovery, attachment of property, etc. have also been included.

PATIALA

RANBIR SINGH

THERE has been regular light to moderate showers at intervals during January-March which have proved very beneficial and useful especially to rain-fed areas. As a matter of fact it gave new life to the crops. After sowing of *rabi* crops up to the end of January the prospects of *barani*-sown crops were very gloomy but the general agricultural condition revived to a considerable extent throughout the State on account of these late rains. The late showers in the first fortnight of March created apprehensions of severe damage to gram crop by washing away of pollens but the actual yields proved that the fears were unjustified.

These rains have improved the average yields of gram, barley and wheat to a fair degree.

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The grain is of uniform colour and well-developed in almost all the cereals.

Sugarcane

The rains in the latter part of the quarter ending in March hampered to a great extent cane-crushing operations. Abnormal drop in the price of *gur* in January-February was one of the reasons for the delay of crushing. The rate was as low as Rs. 7 per maund. The market has since taken an upward trend for which reason crushing was rushed through late in the season. The rate has gone up by about Rs. 4 per maund. It has, however, adversely affected the sowing of sugarcane during the present *kharif* season. It is expected that on account of low rates of *gur* prevailing in the past year the area under sugarcane would appreciably fall during the present *kharif* season.

Labour position

The labour problem in the Punjab States deserves very serious consideration. The usual farm labour has migrated. The immigrants are reduced to penury. The prices of daily necessaries are simply exorbitant. Hence the labourer cannot maintain himself and his family unless he can earn enough quickly. Most of the labour has migrated to urban areas where money can be acquired quickly, leaving the farmer face to face with a very difficult problem, e.g. want of labour. As a result, the zamindar or the farmer had to pay exorbitant rates for harvesting (Rs. 3 to Rs. 7, sometimes with food, a day). A possible solution may be found in the permanent settlement of the refugees on lands.

Exorbitant rates of vegetables

There has been and there is still a great deal of shortage of green vegetables. The supply is too meagre to meet the demand which has resulted in keen competition. Vegetable-growing was mainly done by non-Hindus and with their exodus great scarcity has been experienced. The prevailing rates of some of the articles are given below:

Ghia as. 12 per seer; *karela* as. 12 per seer; onions as. 3 per seer; *bhindi* Rs. 2 per seer.

Cattle and cattle epidemics

The general condition of the cattle has been fair to good throughout the State. There has been plenty of green fodder for them. Epidemics of foot-and-mouth and rinderpest broke out in several villages, causing heavy deaths. All possible veterinary aid was offered by the veterinary staff. The cattle were inoculated against rinderpest.

Marketing Act enforced

To improve the condition of sale and purchase of food grains in the State markets, the Marketing Act has been enforced from 1 April, 1948. This has a healthy effect on the rural population but some resistance is being observed by the commercial community. The Act has been enforced to save the ryot from the unauthorized and heavy market charges.

New Agricultural Commissioner

Sardar Bahadur Sardar Kartar Singh, ex-Assistant Director of Agriculture and Special Development and Planning Officer, Punjab has taken over the office of the Commissioner for Agriculture, Patiala relieving Sardar Bahadur S. Harchand Singh. The State is very fortunate in getting the services of such an experienced officer to improve the agricultural industry of the State on which the future of about 80 per cent of the population rests. There is great scope for agricultural improvements and development in the State and it is expected that Sardar Bahadur would not lag behind in watching and safeguarding the interests of the ryot of the Department entrusted to his care.

AGRICULTURE DURING FIRST YEAR OF FREEDOM

THE solution of some of India's most pressing problems lies in increasing agricultural production so as to make our nation self-sufficient in food in the shortest possible time. For the primary need, without which neither freedom nor life itself can exist, is food. There is no disentangling of this theme from the future politics and economics of our country. It is in the realization of this basic fact and in the steps taken to meet the challenge of recurring food crises in the country, that the last twelve months of newly-won freedom register the greatest change.

August 1948 is an appropriate month for looking back at what has been accomplished in agriculture in the past 12 months. It has generally been a good year for crops and for the agricultural producer. It has been a year without heart-breaking losses through crop diseases or mortifying reverses because of disastrous failures of the monsoon or unprecedented floods with one exception, Madras, where because of a prolonged drought there was a shortfall in production by over a million tons.

For four years prior to August 1947, the Government had concentrated their efforts largely on food distribution. This was inevitable because as a result of the loss of Burma rice all available internal supplies of foodgrains had to be distributed on an equitable basis. Before the appropriate machinery could be set up, came the tragic Bengal famine, which more than anything else focussed public attention on the seriousness of India's food problem. The Report of the Foodgrains Policy Committee of 1943 formed the basis of Government policy during the next four years. Its main planks were : controlled prices of foodgrains, their controlled distribution and procurement under the aegis of the Government. This policy worked with remarkable success and received unqualified praise from international observers and Missions. But its continuance depended upon the willing cooperation of millions of cultivators scattered throughout the country, who had to sell their grain to Government at 'controlled' rates. Dissatisfaction at the 'controlled' prices paid to the agriculturists for their produce gradually grew, and this gathered momentum with the coming into power of popular Ministries in the provinces. Internal procurement decreased ; a section of the popular opinion rebelled against regimentation in food, and Mahatma Gandhi's powerful voice was raised in favour of self-reliance. This led to the appointment of the Purshotamdas Committee in September 1947 charged with the 'more important task' of recommending measures which would 'secure a definite increase in food production within the country during the next five years'.

'Grow more food' campaign

Before we pass on to the recommendations of the Foodgrains Policy Committee, it is necessary to clear up some prevalent misunderstandings of the 'grow more food' campaign and its achievements. The aim with which the campaign was started in 1942, was to offset the loss of rice supplies from Burma. This emergency was not expected to last more than a couple of years after the end of the war. To convert that emergency measure into a scheme for covering the existing deficit in India on the basis of a 12 oz. or 1 lb. ration for the whole population is to throw the blame on measures which were never intended to solve the problem of ever-increasing demands. To quote a high government official in this connection, 'This is to make the same kind of mistake as was done by the British in India when emergency measures to deal with political unrest became the permanent feature of their administration'.

Two other facts are apt to be forgotten in this connection. Agriculture in India still depends upon the closest obedience to the calls of the seasons and a few weeks of cloudy weather or drought may affect the food supply of a year. This happened in two successive years in 1946 and 1947. And, secondly, agriculture is a provincial responsibility. The Centre can allocate part of the funds for provincial schemes, it can offer technical advice, carry out research, offer guidance, coordinate supplies of essential materials and undertake complex organization and technical schemes, e.g. planned irrigation by tube-wells served by electric power, or land reclamation through mechanized means, but it is ultimately a provincial responsibility to 'make two blades of grass grow where one grew before'. It is a wise provision in the proposed new constitution therefore to place the responsibility for food production fairly and squarely on Provincial Governments.

Against the background of these remarks the following figures of assistance given by the Central Government during 1947-48 to Provincial Governments for increasing production are of interest:

	Loans	Grants
	In 00,000	
	Rs.	Rs.
Irrigation	62	101
Land clearance and development ..	15	75
Manures distribution ..	24	23
Seeds	26	17
Fish production ..	2	2·5
Fruit schemes ..	..	2·5
Dairy schemes ..	..	21·5
Livestock schemes ..	4	4
Miscellaneous schemes ..	5	17

Increased production

Compared with 1946-47, the estimated total outturn of the seven major foodgrains, i.e. rice, *jowar*, *bajra*, maize, wheat, gram and barley, shows an increase of 1 million tons, the figures for the two years being 39,423,000 and 40,419,000 tons respectively.

The Foodgrains Policy Committee's Report has recommended a target of increased annual production of 10 million tons, within the shortest possible time. This is to be achieved through large multi-purpose projects which will provide assured irrigation; intensive efforts to raise the production from the soil already under cultivation by increased use of water, manure and improved seeds, and the development of culturable waste lands. The expected increase in production from multi-purpose projects is 4 million tons, from the existing food production plans of provinces and States within the next five years 3 million tons and the balance is to be bridged by the reclamation and cultivation of culturable waste lands of all types.

Land reclamation

One of the most important development in agricultural production since the advent of freedom, has been the undertaking by the Dominion Ministry of Agriculture of large land reclamation projects in different parts of India with heavy tractors and ploughs. On December 16, 1947, a scheme of land reclamation through mechanization—described as the largest in the East, excluding Soviet Russia—was put into operation in the Meerut District of the United Provinces, when heavy mechanical machinery moved up the first sods of 50,000 acres of culturable waste land overgrown with jungle and tall grasses. This scheme has since been followed by two other similar schemes in the United Provinces, one in Central Provinces and one in the Matsya Union. The Ministry of Agriculture has therefore assisted provinces to reclaim about 45,000 acres of land so far through tractors, either imported from U.K. and the U.S.A. or rehabilitated in their own workshop at New Pusa, New Delhi.

The Report of the Foodgrains Policy Committee is being examined by the Government of India in detail, but in view of the difficulties and the time required in obtaining the necessary machinery and other equipment it may not be possible to reclaim more than 6 million acres in the next five to six years. Preliminary survey work cannot be carried out on more than 2 million acres per annum. This in itself will limit the speed with which land reclamation work can be undertaken. And if the country accepts the target of reclaiming 6 million acres of new land, it will be necessary to purchase additional 1,000 machines. In the present state of world production and demand, we cannot expect more than 300 machines at the end of the first eighteen months and thereafter 300 machines every year. These machines will require an equal number of heavy reclamation ploughs and an adequate number of brush clearing and drainage equipment sets. It is possible to manufacture heavy reclamation ploughs in India but certain component parts will have to be imported.

Machines vs bullocks

It is necessary here to emphasize that tractors cannot replace bullocks in India. There are certain basic factors which must limit the extension of tractor cultivation in India. The minimum area of land on which a 25 to 30 H.P. tractor can be economically used is 150 to

200 acres. The rotation of crops must be of an intensive nature so as to ensure employment of the tractor for at least 1,800 hours in a year. This means that the land must be fully irrigated and must be double-cropped. Rice cultivation, therefore, in India does not lend itself to mechanical cultivation, nor the large areas under other crops which do not have an adequate supply of rainfall. Bullocks must, therefore, continue to be the main source of power for cultivation in India for all time unless there is an economic revolution in the country.

As has been stated at the beginning of this article, agriculture is a long-term undertaking; several months have to elapse between the sowing of the seed and the garnering of the crops in the fields. No revolutionary change or dramatic advance can therefore be registered during the brief period of a twelve-month. What however cannot be missed is the anxiety of the Government to solve the problem quickly, and the realization probably for the first time that in any scheme of national uplift, the actual tiller of the soil has to play the leading part. With characteristic impatience Shri Jairamdas Daulatram, the Dominion Agriculture Minister, told the members of the Purshotamdas Committee : 'I hope that the scheme of food self-sufficiency which you will produce can be implemented in a very very limited number of years—not beyond five. I wish it were two'. And the one theme which runs through all his speeches is the urgency of the problem.

Symbolic of the changed attitude of the Government to the primary producer is the increased emphasis which is now being laid today on the manufacture of compost from town-refuse and *gur* from palmyra juice. Today about 20,542 village centres are manufacturing nearly 12,50,000 tons of compost from refuse, and nearly 200,000 tons of *gur* is being made from palmyra toddy. These are small beginnings, but they have blazed a new trail. Instead of intoxicating people, the conversion of palmyra juice into *gur* is helping to resuscitate a dying industry and to provide supplementary occupation to our cultivators spread over lakhs of villages.

In theory, much more could have been done for the actual tiller of the soil. But it must not be forgotten that our *kisan*, with the mentality to obey the quiet order of the seasons, does not easily acquire the facile optimism of the city dweller. Too often he has seen drought, flood or pest destroy the fruit of his toil and learned from it patience and submission. His is a minute economy to which a small loss means ruin. All attempts to reform Indian agriculture must fit in with the *kisan's* economy. That is an appropriate background to India's agricultural policy during the first year of freedom. (*P.I.B.*)

Across the Borders

THE BREEDING AND REARING OF DUCKS

THE selection of breeding ducks from first-year stock is common, particularly if the owner wishes the eggs to hatch early in the season. Early hatching has advantages when ducks are being raised for table birds, but there is much to be said for retaining successful breeders for several seasons, and in general ducks have a longer breeding life than the average for poultry. In normal times overseas some flocks of first-year ducks are trap-nested and the breeding stock selected from these birds, judged on their first-year egg production.

Selection of the right type of bird

Birds having wide, long, and deep bodies are desirable as breeding ducks for egg production. Coarse-headed birds, male or female, should not be used, as heavily producing ducks invariably have fine heads, and when in lay have well-developed, deep bodies. Every endeavour should be made to select only ducks and drakes which weigh not less than the minima stipulated under the New Zealand Poultry Flock Improvement Plan. Breeding pens should be made up not later than August or September, as the hatching season is in full swing in October.

Two types of matings may be made, by single-drake pens or mass-mated pens. In single-drake pens rather fewer ducks should be allowed to each drake. With the egg-laying breeds such as Khaki Campbells and Runners eight to ten females may be mated to one male, but with the heavier breeds such as the Pekin duck the number should be lower, say five to eight females to one male. Though mass mating of ducks is common, the best results are usually obtained with single-drake matings.

Satisfactory results can be obtained with breeding pens which do not have access to water for swimming on, but some experienced duck breeders believe that better results are obtained from ducks which are given the natural conditions of water during the breeding season.

Eggs for hatching

Eggs for hatching should be collected daily as soon as the ducks are released and should be washed as soon as possible. It is not recommended that duck eggs required for hatching be subjected to a long soaking in water before being cleaned. Provided all mud or droppings are removed, it is not essential for hatching eggs to be cleaned to the extent desirable when they are to be marketed.

Little or no deterioration in hatching results is experienced with poultry eggs kept for 10 days if they are stored under satisfactory conditions and turned regularly, but it is desirable to set duck eggs for hatching as soon after they are laid as is practicable. Much will depend on how long is required to collect sufficient eggs to fill a flat-top incubator or give a setting for a cabinet machine, but it is recommended that duck eggs should not be held longer than seven days, and there is some evidence to show that eggs held for even that period hatch better under hens than in an incubator.

A cool place should be selected for storing eggs for hatching and if they are kept for seven days or longer, they should be turned daily. Turning daily is less important if the eggs are stored on their ends, small ends downward. Care should be taken to reject cracked or rough-shelled eggs. A good medium-sized egg is desirable, undersized and abnormally large eggs being better avoided.

Incubation

As with poultry eggs, duck eggs may be hatched by natural or artificial methods. Hens are employed for natural hatching and heavy-breed birds will cover 10 or 11 eggs. Putting too many duck eggs under a hen is not wise, particularly if she is to complete the operation of hatching. As the incubation period for duck eggs is 28 days (35 days for Muscovy ducks) the hens used should be fully broody, in good condition at the start, and free from vermin. Such birds may be freed of vermin by the use of nicotine sulphate, pyrethrum powder, or sodium fluoride.

An important aspect of hatching duck eggs is that they require more moisture than is necessary for hen eggs. Accordingly the hatching coop or box used for hens sitting on ducks' eggs should not have a wooden bottom and should be placed directly on moist or damp ground. This natural moisture is of great assistance in duck-egg hatching. The floor of the coop may be made of a fine-mesh wire netting to protect the hen and eggs against rats or other vermin. The nest itself should be made of a layer of straw or hay placed on the netting. In dry districts it is often desirable to moisten the ground around the coop with water a few days before the eggs are due to hatch.

All broody hens should be taken off the nest daily for about 20 minutes after the first two or three days. During this period the hen relieves herself, feeds, and drinks. Grain feeding, particularly with maize, is satisfactory for broody hens. The eggs should be checked over seven to ten days after being set and all infertiles removed. Careful observation is necessary throughout the hatching period to detect eggs is which the germs have died and the contents are going bad. Bad eggs are not uncommon among duck eggs during hatching, and should they burst, all the other eggs may be badly soiled and the broody hen may desert the nest.

Incubator methods

The hatching of duck eggs in an incubator, either flat-top machines or cabinet incubators, is common today, but it is perhaps true that an incubator eminently suitable for hatching duck eggs has yet to be made. The best method of operating an incubator for hatching duck eggs varies to some extent with the type of incubator and experience with the machine will have to be acquired before the best results are obtained. For that reason some marked divergences of opinion exist among those who have had experience of hatching duck eggs. However, the following points may act as a guide :

Flat-top machines are usually run at 103 degrees F. with a rise of up to one degree at hatching time. Duck eggs should not be heated up too quickly and the doors may be left slightly ajar during the first six hours. No harm is done if 12 hours elapse after setting before the temperature reaches 101 degrees, and a further two or three days before the limit of 103 degrees is reached. The first 10 days are the critical ones, during which the eggs should be disturbed as little as possible—in fact, it is customary in the United States not to turn the eggs at all until the first test is made at the end of a week, and that method is also adopted by some duck farmers in New Zealand. Duck eggs may be tested for fertility seven to ten days after setting. A daily watch must be kept for eggs going bad ; they may be detected readily by smell in the early days of going rotten.

Opinions vary on the question of cooling duck eggs, but it is suggested that cooling after the first week has advantages for eggs hatched in flat-top machines. Apart from any direct effect that the cooling may have on the embryos, this practice undoubtedly helps in the efficient ventilation of flat-top machines and affords the eggs an increased supply of oxygen. These remarks do not apply to eggs hatched in cabinet machines.

Experiments before the war indicated that a high humidity—say 70 per cent—is desirable for duck eggs in an incubator during the first week, with a subsequent reduction of about 5 per cent a week until hatching time, when the maximum moisture is required.

Similar treatment of duck eggs is required in a cabinet machine, except that the temperature is maintained at 100 degrees F. Special trays are required to pack duck eggs because of their greater size than hen eggs.

Rearing ducklings

Given reasonable care, ducklings are easier to rear than chickens. They require a shorter brooding period during which warmth is necessary and are far less liable to disease. Against that must be set the increased difficulties of keeping conditions clean with ordinary brooding equipment. The usual types of litter such as straw, chaff, and rice husks rapidly become damp, soiled with droppings, and trampled into a messy condition.

If only a limited number of ducklings is to be reared, natural methods can be employed with excellent results. Some form of coop is required for the hen and ducklings for the first few days, and for protection at night throughout the brooding period where rats are likely to cause trouble. Rats and weasels are particularly deadly to young ducklings and protection against these menaces must be provided. If there is a hedge, shrubs, or some other protection to which the hen may take her ducklings during the day to avoid rain, hot sun or cold wind, such protection as coops during the day is unnecessary. After two or three weeks the ducklings may be taken away from the hen and kept in a pen having a simple open-fronted shelter for protection at night and when necessary during the day. A heavy-breed hen will brood 15 ducklings comfortably.

Ducks may be reared artificially using almost any of the ordinary types of brooders. It is now becoming common to rear ducklings in battery brooders, where they are maintained for two to three weeks. Battery brooders are favoured for their wire floors, which enable conditions to be kept cleaner and more hygienic than with floor brooding. When the floor brooding method is selected it is desirable to make wire frames for under the hovers to overcome the dirty conditions that ducklings create. Ducklings should be started at a temperature of 90° F. under the brooders, as with chickens, but the temperature may be dropped more quickly. In warm climates artificial heat may be dispensed with after about a fortnight. Ducklings may be allowed only a very limited range from the hover during the first two or three days ; brooder surrounds of wood or metal should be used to confine them to this space. As ducklings produce liquid droppings and grow very rapidly, efficient ventilation in the brooder house or shed and under the canopy of the brooder is essential.

Ducklings may be allowed outside the brooder house pen after two or three days. If grass runs are provided, the grass should be kept short. Wet long grass is not suitable for young ducklings, as such conditions lead to chills. A modern method of running them is to provide a shallow cage outside the brooder house pen raised off the ground and having a fine-mesh wire netting bottom or slatted wooden floor. The ducklings go out into the extensions or cages for food and water and benefit from direct sunshine. With this type of floor the cage remains reasonably clean during the short brooding period.

Plenty of water required

The feeding of ducks and ducklings will be described in detail in a later article, but it may be emphasized that ducklings require plenty of fresh drinking water to be constantly available. It is a generally accepted practice to ensure that the depth of the drinking water is sufficient to permit the ducklings to immerse their heads completely, ensuring that the beaks and nostrils are kept clear of food accumulations and the eyes of sores. The writer was surprised on one occasion recently to see young ducklings provided with a drip-feed drinker and to note no trouble from dirty beaks or sore eyes.

Any simple system of penning on grass attached to a low, open-fronted shelter will suffice for the growing period. It is important to note that ducks are inclined to be nervous and are easily frightened, particularly by dogs, cats, or rats. For that reason it is desirable to run growing ducks in comparatively small units—30 to 40 birds. Less damage is then done if the birds are frightened, as in big flocks ducks are likely to pile up on one another if frightened, causing damage. This point has to be watched when catching ducks in a pen.—Reproduced from *New Zealand Journal of Agriculture*, Janurary 1948.

Home Gleanings

PROBLEMS OF WORLD POPULATION

WITH memories still vivid of the disasters flowing from the 1943 Bengal famine, and its succeeding epidemics, any new consideration of the larger problems of population in relation to nutrition and food policy, industrial development, agricultural productivity, and world peace must have a special interest for everybody concerned with India's economic future. There is nothing specially new in the thesis that whatever success be achieved in increasing food production a decreasing rate of population growth is not merely desirable, but ultimately essential. It was stated as recently as 1945 in the recommendations of the Woodhead Commission's final report from the Indian Famine Enquiry (paragraphs 19-21), and English sociologists from Malthus to Carr Saunders have suggested that the growth of population would finally tend to nullify the advantages of economic progress. But its re-statment by two American researchers, projecting it as a fundamental issue of peace or war, is particularly timely when the most notable recent schemes for Indian economic development—the Bombay Plan, the People's Plan of the Indian Federation of Labour, and the 1944 Reconstruction Proposals of the Government of India—all envisage their primary problems in terms of increasing total national income by raising total production of real goods and services, by one method or another, rather than from the approach of population restraint.

Menace of population

Mr. Guy Irving Burch, Director of the Population Reference Bureau, Washington, D.C., and Mr. Elmer Pendell of Baldwin Wallace College, Ohio, state their argument* with brutal simplicity. It is that 'uncontrolled human reproduction not only favours the survival and multiplication of the least gifted members of society; it menaces, and in the long run will destroy human liberties and any chance for a world at peace'. They reject the assumption, implicit in most plans of reconstruction or development, that technological progress will keep pace with population increases, and that if distribution problems can be solved there will be enough of the world's goods to free the world's peoples from want except with 'humane and intelligent population limitation'.

Between 1900 and 1940 the earth's population rose by 563 millions to 2,200 millions, and in the ten years before World War II by 200 millions. At recent rates of increase, and failing further world-scale catastrophes of war, famine, or disease, it might reach 3,300 millions by the end of this century. Paradoxically, say Mr. Burch and Mr. Pendell, such little 'freedom from want' as the peoples of India and China enjoy is due chiefly to their high death rates: and if these could be reduced, say, to America's level either country could fill five worlds the size of this within a hundred years. Russia could do the same in little more time. In face of such actual and potential population increases, they suggest, such assertions as that 'beyond any doubt men now possess the technical ability to produce in great abundance the necessities of daily life—enough for everybody' ('The United Nations Fight for the Four Freedoms,' published by the U.S. Office of War Information) are no more than wishful thinking. Germany is cited as the most notable modern example of rapid technical industrialization, but although the German people were little behind the Americans or Canadians in intelligence and industry their pre-war living standards were only half as high (Colin Clark: 'The Conditions of Economic

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**Human Breeding and Survival: Population Roads to Peace or War.* By Guy Irving Burch and Elmer Pendell (Pelican Books).

Progress'); and even in the United States, the world's most highly-productive country, one-third of the people lacked adequate food, clothing, and housing at the start of World War II.

The key problem

The failure of all attempts so far to prevent war in Europe and Asia, while Canada and the United States have not fought each other for more than a hundred years, is attributed directly to the respective relation between population, natural resources, and technical development in the two hemispheres. And here, it is claimed, is the key problem for the United Nations, in their essential task of averting war for the next fifty years, because of three broad considerations: (1) an industrialized nation whose population is rapidly expanding is likely to try to extend its borders, and so threaten world peace; (2) a nation with scant surpluses of goods above those needed to support its population is vulnerable in time of war; and (3) a nation with surpluses of goods can not only support its people at a high level of living, but can also be powerful in war. And in connection with the argument that overpopulation threatens peace because aggression, rather than population restraint, is superficially the obvious way of staving-off poverty, it is emphasized that prospects of access to new and fertile territories are now apparently small; that much of the earth's surface is waste land, incapable of cultivation at present levels of science and enterprise; and that reckless use of soil and mineral resources has destroyed or greatly diminished the productive possibilities of vast areas which were once the source of abundance. Dr Hugh B. Bennett, of the U.S. Soil Conservation Board, told the House of Representatives' Committee on Labour in 1939: 'Today the total productive soil of the world is stringently limited. There are only about four billion acres of arable land to fill the needs of two billion people. That is two acres *per capita*, although nutritionists say that 2½ acres *per capita* are necessary to provide even a minimum adequate diet. Not all the four billion acres is good farm land; only about one-fourth constitutes what American farmers would consider as really good productive soil. And some nations have less than an acre of productive land *per capita*'.

Population and forms of government

The relation of population density to the maintenance of democratic institutions, and to the emergence of autocratic forms of government or dictatorships, has been sufficiently illustrated in recent history to need little elaboration. There is clearly more independence of spirit and originality of thought in a rich and lightly populated land than in an overcrowded country where pressure of population has helped to create an unemployment problem among people without property or work in agriculture, who must seek a livelihood in industry or by service. In these circumstances, as experience has shown, an active and articulate minority, even if numerically small, can often control policy in most forms of social association. In that sense democracy can soon come to mean little more than formal legal equality, with perhaps nominal equality of right to elect representatives for some form of government. Such extreme manifestations of poverty and political depression as, for instance, the 'Untouchables' of India are also no doubt partly attributable to biological inheritance, religion, culture, and climate, but increasing density of population is as interwoven influence.

Control of population

Meeting the optimists half-way in their claim that we have enough technological ability to produce enough for everyone, Mr. Burch and Mr. Pendell suggest that if 'everyone' be taken as the 1940 population of 2,200 millions it might be possible to stabilize world population at this figure in about 110 years. This could first involve an increase of 25 per cent in the next 50 years, because the rate of population growth has gained such momentum, and 'young' age groups in most countries are so large, that unless the rate of increase is slowed gradually the population may become too old. From the start of the next century, it is calculated, a gradual decrease of about 10 per cent every 30 years would settle population at about the 1940.

The methods by which this goal could be reached fall into two broad categories—emigration being ruled out as an effective contribution to the problem—'preventive' checks, operating before the conception of new life, and 'positive' checks, limiting population growth after new life has been conceived. In the latter class are war, famine, pestilence, and undernourishment, which should have no place in an enlightened civilization. In the former, and varied in different countries according to religion, education, and social and economic position, come contraceptive birth-control, the so-called 'rhythm method', late marriage, continence, celibacy, and, in the extreme, sterilization. The religious or moral aspects of this question apart, Mr. Burch and Mr. Pendell vote in favour of birth-control—whatever the impelling motives, it is already effectively reducing the rate of population growth in western countries and has already appeared among the upper and middle classes in India—and it is the basis for their final proposals suggested for the consideration of the United Nations Population Commission.

Their programme, designed to implement what is described as 'The Vital Revolution' has four main immediate points:

(1) UNO can *insist* on the establishment in the Axis countries of an environment in which information about population control for married people will easily be available; and can *encourage* such an environment in Allied and neutral countries. It can also sponsor international population conferences for the periodic exchange of information on population questions.

(2) It can emphasize the responsibility of each sovereign political jurisdiction for taking care of its own population and can encourage migration restrictions against any country which fails to keep its own numbers in control; while helping cooperating countries in every reasonable way consistent with the welfare of the contributing nations.

(3) It can encourage sterilization laws on the bases of social criteria and heredity, to raise the biological quality of the population as well as controlling its quantity.

(4) It can give world publicity to the relation of lax marriage laws with poverty, and can emphasize the need to adopt and enforce appropriate marriage and reproduction qualifications.

It is not to be expected that the thesis so broadly outlined above will find anything like universal acceptance or approval. It will be challenged at many points, and by many interests with which it will conflict on one ground or another. But with a definite post-war tendency to approach social and economic problems from a 'one world' angle the issues it raises are sufficiently important and controversial to justify their widest possible discussion. 'In considering population in its various aspects,' says the Woodhead Famine Report, 'we have been struck by the insufficiency of existing knowledge......such knowledge is vitally necessary to a modern government which is concerned with State planning and the orderly development of the country's resources......it is a subject which, in India as in all countries, has a close bearing on long-term plans of development'.—Reproduced from *Capital*, February 26, 1948.

Book Reviews

A MONOGRAPH ON HANDLOOM WEAVING INDUSTRY IN INDIA, 1947

By M. P. GANDHI (Published by Gandhi & Co., Jan Mansion, Sir Phirozshah Mehta Road, Bombay, pp. 66, Rs. 1-4).

SHRI M. P. Gandhi comes out with this annual for the past few years. The latest one published is that of 1947 which like its previous one is full of new interesting material in addition to material already published before. The Fact-Finding Committee first came out with a large volume of authentic information about handloom industry in India. Later the All-India Handloom Board was appointed by the Department of Industries and Supplies in 1945. The Government of Bombay appointed a committee for the promotion of village industries in the report of which a special chapter was devoted to the handloom production of cloth. During the war years the handlooms showed their capacity and handled a lot of yarn. But with changing times the quota of mill yarn allotted to the handlooms was reduced. Shri Chakravarty Rajagopalachari declared in 1947 in reply to a cut motion in the Central Assembly that eighty thousand bales were placed at the disposal of the handlooms which was nearly one-fourth of the mill production of yarn of those days. But nothing was discussed about the count of the yarn, and whether such yarn as was in demand by the handloom weavers was placed at their disposal.

Shri M. P. Gandhi's publication is helpful in bringing out the case of the handloom weavers to all concerned. A perusal of this monograph will acquaint the reader with the present position of the industry and also with the ways and means of improving the position. The monograph should have wide circulation so that facts of handloom industry may be more widely known and up to date position examined in view of the textile policy of the time. (S.C.D.)

INDIAN COUNCIL OF AGRICULTURAL RESEARCH ORGANIZATION AND FUNCTIONS—PART I

Compiled by S. C. SARKAR (Published by the Indian Council of Agicultural Research, Price Rs. 1-8).

ALTHOUGH the Indian Council of Agricultural Research was set up in 1929 no attempt had hitherto been made to present full information about it to the public in the form of a handbook. The present book removes a long-felt want in that respect. It traces the history of the Council and also gives the rules and regulations relating to its set up and will therefore be of great help to provinces, States, Central Institutes, Universities and other institutions interested in agricultural and animal husbandry research in putting up research schemes for financial assistance from the Council and in the preparation of technical programmes and progress reports of schemes worked by them.

The book is well-planned and well-written. The main body of the book gives an account of fundamentals. Details have been presented in the form of appendices. The first few chapters are devoted to recounting the history, organization, functions, finance, research activities and publications of the Council. This is followed by a brief account of the Central Agricultural Marketing Department and the Central Agricultural and Animal Husbandry Research Institutes. At the end is given an account of the All-India Cattle Show Committee and Central Commodity Committees.

Those who have the thought of national well-being at their heart will like to know everything worth knowing about the Council. The first part gives an account of how the Council and its sister organizations function. We are told that the second part of the book which will contain results of researches carried out so far by the Council will appear shortly. Its publication will be eagerly awaited by all. (D.J.S.)

News and Views

NEW DRUG CURES SLEEPY SICKNESS

By L. ROBERTS

THE name 'phenanthridine' can hardly be current among chemists and doctors, for this substance remained completely unnoticed until World War II, when an English chemist, Dr L. P. Walls, decided to investigate its chemico-therapeutic value. The results obtained by Dr Walls and his colleagues—chemists, bacteriologists and veterinary surgeons—are not by any means conclusive but they have already shown surprising success. The British magazine *Discovery* has expressed the view that the results so far appear 'likely to have a profound effect on the economy of Africa and other tropical and sub-tropical countries, such as India and South America'.

It was no mere guess that led Dr Walls to investigate phenanthridine, for in studying the relevant literature it occurred to him that it formed, with other substances, certain compounds which had structures similar to the physiologically active alkaloids. In particular the arrangement of the atoms resembled that of quinine and pamaquine, both of them valuable remedies against malaria. Phenanthridine is, moreover, chemically related to acridine, of which mepacrine, the most popular anti-malarial drug used during World War II is a derivative and likewise the valuable antiseptic, acraflavine.

Dr Walls, therefore, assumed that there would be some valuable chemico-therapeutical compounds of phenanthridine and set to work to produce such hitherto unknown substances. At the Chemical Research Laboratory of the Department of Scientific and Industrial Research, Teddington, near London, he patiently produced one compound after another. Even the first few had antiseptic qualities.

It was tiring work, but Dr Walls persevered; five, ten, twenty new compounds were produced. Each new substance had to be carefully refined and tested for anti-bacteriological effects. Hundreds of new compounds were made and tested without giving complete satisfaction, until a dramatic change occurred with the production of number 897—named 'Phenanthridium 897' by Dr Walls—which proved an excellent remedy against *Trypanosoma Congolense,* the terrible bacillus which causes trypanosomiasis, or sleepy sickness in animals.

Sleepy sickness is the cause of many deaths each year among men and cattle in extensive areas of Africa, and up to the present it has made economic and cultural development all but impossible in the affected countries. The bacilli which cause the disease—the so-called trypanosomes—are transmitted from beast to beast and from man to man by a small blood-sucking insect—the tse-tse fly. The disease is known as nagana when it attacks animals; mortality is so high that cattle-raising is uneconomic in areas where tse-tse fly abound.

The campaign against this pest has been increased intensely during the last 20 years, by clearing wide areas of the vegetation where the fly breeds, by destroying wild game herds, which are the carriers of trypanosomes and by attacking the fly direct, spraying the affected regions with modern insecticides such as DDT or Gammexane. But the problem is still far from being solved.

Dr Walls has recently published a detailed report of his researches in the *Journal of the Society of Chemical Industries.* His calm, objective statements betray nothing of the excitement which he and his colleagues must have felt when they first observed the extraordinary properties of 'Phenanthridium 897'. They repeated their tests, injected mice with the new drug after infecting them with *trypanosoma congolense*; their first success was confirmed, for the bacilli were killed by the new substance whereas its toxic effect on the test animals was almost negligible.

They had now to test the laboratory results in the real battle-field—the plague spots of Africa, inhabited by the tse-tse fly. Large quantities of the new compound were produced quickly and shipped to West and Central Africa. Enthusiastic reports came back from veterinary surgeons in Kenya, Tanganyika and Uganda who unanimously characterized the new drug as the best 'produced to that date for treatment of the bovine infection'. They state that a small dose—0·3 to 0·5 gr. per animal—is quite sufficient, and that recovery usually began after a single injection. As the drug is cheap to produce, it seemed that mass treatment of herds was well within the bounds of possibility.

The reports from Nigeria were less satisfactory. Apparently the type of trypanosome occurring there had greater resistance, and the position remained so until 1943, when continuous tests on the spot made it clear that an improved type of the drug would be desirable. 'Phenanthridium 897' has, as already explained, a toxic action, slight but nevertheless undesirable. Furthermore, the injections are administered intravenously which demands a certain degree of skill.

Once again Dr Walls set himself to the task of forming new compounds with phenanthridine, and dozens, hundreds of previously unknown substances were isolated, refined and tried by tedious experiments with test animals for their chemico-therapeutic value. In this work Dr Walls received valuable assistance from Professor C. H. Browning, Director of the Glasgow Bacteriological Institute.

Two further drugs, numbers 1508 and 1553, were tried out in Africa and proved to have several advantages compared with 'Phenanthridium 897'; in particular they could be used as ordinary subcutaneous injections. The production of the new drugs on a large scale, was therefore undertaken.

In the course of the work it was found that another of the phenanthridine series—1544, was of special value against a similar bacillus, trypanosoma cruzi, the cause of the widespread disease known as Chagas sickness, which mainly attacks children in South and Central America. Number 1544 should be noted, if only because it shows how many troublesome experiments are required to produce a new medicine. Dr Walls' work has already shown that phenanthridine compounds represent an important step forward in the campaign against diseases caused by trypanosomes. Further developments are awaited with great interest. (*B.I.S.*)

PLANT PROTECTION MEASURES

VARIOUS measures have been taken by the Directorate of Plant Protection, Quarantines and Storage set up by the Ministry of Agriculture during the last 12 months to bring under control insect pests and diseases of crops responsible for the loss of about 10 to 15 per cent of crop yields in India.

With financial assistance of the Central Government under the 'grow more food' campaign, plant protection schemes have been in operation in Bihar, West Bengal, Orissa, Central Provinces and Bombay and in the centrally-administered areas of Ajmer-Merwara, Coorg and Delhi. The Directorate has also helped in setting up a Plant Protection Organization in the United Provinces.

The desert patrols of the Directorate have kept watch over the locust breeding areas throughout the year to detect developments of scattered locusts and to nip incipient outbreaks in their early stages. The country has remained free from infestation, though swarms are still active in parts of Arabia and Africa.

The Wheat Rust Committee of the Government of India that met in 1947 considered that the widespread rust epidemic of 1946-47 in Central India was due to infection by rust spores from *kharif* wheat grown on the hill ranges of southern India, in Mysore and south Bombay, carried by upper air currents to the affected parts. As advised by that Committee, steps were taken by the Central Government for securing the prohibition of such summer wheat cultivation by the Governments of Madras, Bombay, Mysore and Travancore.

A coordinated scheme of biological control is in progress with a Central Breeding Laboratory at Bangalore from which predatory beetles, bred in bulk in cages, are distributed for release in various affected areas, e.g., Travancore, Coorg, Mysore, Madras and Bombay for the control of a dangerous pest of oranges, wattle and casuarina. The infestation in the affected areas has been greatly reduced and the further spread of the pest checked.

In order to prevent the introduction of foreign insect pests and plant diseases by sea, land and air along with imported plant material, it is proposed to establish quarantine stations at most points of entry from abroad. Suitable sites for establishing modern fumigation plants have been selected at Bombay, Calcutta and Madras, and a vacuum fumigation plant has been ordered in the first instance for Bombay. Similar fumigation apparatus will also be established at other sea ports.

The Storage Division of the Directorate, designed to devise measures for prevention of damage by insects, rodents and moulds during storage, has carried out the disinfestation of immense stocks of imported grain at the main ports of entry, viz., Bombay, Madras and Calcutta.

In June-July, 1948, a training course was arranged at Nagpur to train candidates for storage and plant protection work. Such courses are to be arranged at other centres also from time to time.

COVER ILLUSTRATION

Drag net in operation

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol IX : No. 10
OCTOBER 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.10.48
2,800

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department, (Publication Branch), India House, Aldwych, London, W.C.2.

INDIAN FARMING

OCTOBER, 1948

Vol. IX No. 10

KEY VILLAGE, THE CORNER STONE OF CATTLE IMPROVEMENT IN INDIA

THERE is a limit to the number of farms that can be established by Government and consequently, they cannot be expected to meet the demand for the large number of bulls required for improving the 179 million head of cattle in India. Some Government farms are, however, essential but they can be really effective only when worked in conjunction with the villages. Not that the villages have been neglected hitherto. They have received attention. Bulls have been produced and distributed in villages. Scrubs have been castrated. Disease control has been attended to. Propaganda and demonstrations of various kinds among villagers have been undertaken. But all these measures have not produced the desired results because the effort was too small for the task and, in the majority of cases, there was no plan or system behind it. The bulls bred on the farms were indiscriminately distributed and there was no concentration or continuity of effort. Experience has shown that effort should be concentrated continually in small, compact and suitable areas till they are improved and then the improvement should be made to spread to other parts in a gradual and ever-widening circle.

It is now generally agreed that the key village has a very important role to play in all our livestock improvement plans and if judiciously exploited, it is likely to yield results of far-reaching importance. As, however, the key village is still in its infancy, a clear perception of its scope and functions and how it may be organized and developed is necessary for ensuring uniformity in design and execution.

The key village has been described and defined as a compact area consisting of one village or a group of contiguous villages having a total population of about 500 cows. It is selected in a breeding tract and seven to eight bulls of known breeding value, are located there. All the other bulls in the area are castrated or removed and no bull other than the selected seven or eight is allowed in the area at any time. A Livestock Improvement Act, similar to that passed in Bombay, Madras and elsewhere, is enacted and enforced in the area. When these bulls become too old to be of service, they are replaced by an equal number of equally good or better bulls, so that, in the course of four or five generations the entire stock of the key village is of a superior strain. The bulls from the key village are then available for distribution in other areas. Each key village with a population of 500 cows should produce about 100 bulls annually. The farm-bred bull is thus multiplied 10 to 15 times. By planned distribution, the area of location of bulls sent out from key villages, can also be defined so that the improvement proceeds in accordance with a pre-planned programme. Bulls are thus produced on the farms, multiplied in key villages and distributed in other well-defined areas.

The above picture of planned improvement may be contrasted with what is being done today. The number of bulls produced at present on the farms is only 1/250 of the actual requirements. These are often indiscriminately distributed, with the result that one improved bull is placed among a host of 250 scrubs, which, in many cases, nullify in the second generation the improvement produced by the approved bull in the first. Under this system, little improvement is possible. The key village is designed to put a stop to this haphazard practice which has been going on for years.

Only a bare outline of the key village has been given in the foregoing paragraphs. If properly organized and developed, the key village is pregnant with potentialities for the improvement not only of cattle, but of all species of livestock. Experience has, however, shown that in planning the development of key villages one should hasten slowly. During the past few years, the Indian Council of Agricultural Research has established a number of key villages designed to operate with a full programme of breeding control, such as maintenance of complete records of breeding and milk production, and tattooing or branding for identification. The attempt failed to produce results. It is clear now that this detailed programme can be introduced only by stages. The first stage of development should be merely the establishment of the key villages, with the approved bulls suitably located, existing bulls removed or castrated and the whole cattle population protected against contagious diseases. In the second stage, which will be five years after the establishment of the key villages, full breeding control should be introduced. Other measures of cattle improvement like preservation of surplus monsoon fodder or of fodder as silage, hay-making, cooperative purchase of feeding stuffs, cooperative sale of milk and milk products, may also be taken up in the second stage. In the third stage, the maintenance of complete records of breeding and milk production, tattooing or branding of the animals for identification should be undertaken. Other investigations on the economics of milk production, suitability of feeding scales, transmitting ability of breeding males and cognate matters can also then be conducted and accurate data obtained for planning further improvement. When the third stage is completed, it should be possible to select breeding stock on the sure basis of pedigree and production. The improvement thereafter will be rapid. If organized and developed with vision and understanding, the key village will be the corner stone of the mighty edifice of cattle improvement in India.

The number of key villages needed depends on the number of breeding bulls required for the country. The Indian Dominion has a total of 65 million cows, which require (at the rate of 1 bull per 65 cows) one million bulls to be constantly at stud. The average length of useful life of a bull in India being about four years, the full requirement of the country can be met if 2,50,000 bulls are produced annually. It has been mentioned above that a key village of 500 cows can, when fully developed, produce about a hundred breeding bulls fit for further distribution. In the initial stages, however, when heavy culling is necessary and when calving interval is long, not more than 40 bulls per village may be expected. A total of 1,500 to 1,600 key villages will, therefore, provide initially, about 25 per cent of the country's requirements of bulls. It would not be wise to set a higher target to begin with.

In order that these key villages may be properly developed and in order that they may be made to serve the purpose for which they are established, it is essential that their planning be linked up with a well-defined breeding policy for the country. In certain areas definite breeds exist. They can be developed by selective breeding. In other areas, cattle are of inferior and mongrel type. They have to be improved by the use of bulls of exotic breeds. This grading up, which involves at least 60 per cent of the country's cattle, is a huge and complicated problem and various aspects of it must be investigated and studied. The primary responsibility for the development of livestock lies with the provinces and States, but the problem is so immense and complicated and the provinces so inter-dependent in respect of cattle, that it is impossible for any single province or State to undertake this huge task on its own. Full collaboration between the provinces and States and efficient coordination, guidance and help from the Centre are thus essential for the harmonious development of the country's livestock as a whole.

CONTROL OF SUGARCANE LEAF HOPPER (*PYRILLA* SP.) IN THE U. P.

By B. D. GUPTA

THE leaf-hopper (*Pyrilla perpusilla* Wlk. and *P. pusana* Dist.) has been, in recent years, one of the most serious pests of sugarcane in many cane-growing tracts of India. The expansion of the sugar industry and the spread of high-yielding varieties of cane has helped this pest to occupy a front rank among the crop pests of the United Provinces. Serious outbreaks have been reported in the past from the districts of Muzaffarnagar, Meerut, Bulandshahr, Sitapur, Lakhimpur-Kheri and Gorakhpur of this province.

An idea of the extent of damage which this insect is capable of causing can be had from the fact that during the severe Pyrilla epidemic of 1937-38, in the western United Provinces, the recovery of sugar in mills decreased considerably in heavily attacked areas and it became difficult for the cultivator to make good quality *gur* from the infested crop. Such epidemics are known to have occurred in the western United Provinces also during 1930-31 and 1934-35.

A regular study of this pest was commenced in the United Provinces with the inauguration of the Sugarcane Research Station at Muzaffarnagar in 1934 under the auspices of the Indian Council of Agricultural Research. The present note, based on the investigations carried out so far, is a popular account of this pest dealing with the various factors underlying the occasional outbreaks and the measures that have been found effective to control the pest.

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Life-history and seasonal incidence

The details of the life-history and the duration of the egg, nymph and adult stages of this insect in the western United Provinces broadly agree with those described by Rahman[1] in the Punjab. Over-wintering nymphs develop into adults after the middle of March. Egg-laying starts after the first week of April and continues up to the middle of May. The eggs are mostly deposited on the shoots of the stubble or on the crops planted in previous October. The development and survival of nymphs during May and June depends mainly on the prevailing conditions of temperature and humidity of the atmosphere. The mortality of nymphs is usually high during the dry hot weather and the survivors develop into adults by about the first week of July. If, on the other hand, high atmospheric humidity prevails during May and June, they become adults much earlier and without any appreciable reduction in numbers. The eggs of the second brood are deposited mostly on the plant crop in July. The eggs of the third brood are laid from after the middle of August and continue up to the end of September. The eggs of the fourth brood are laid during October, November and December, after which the adults mostly perish under the influence of low temperatures. The cycle is continued in the following season mainly through the nymphs which develop into adults in the month of March, thereby completing four broods during the year. The first two broods are well-defined but from September onwards there is an over-lapping of broods and all stages of the pest are met with up to December.

In the Punjab, Rahman and Nath[2] have noted a large number of plants as alternative hosts of Pyrilla. In the United Provinces it has been observed that late-ripening oats

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[1] Rahman, K. A. *Indian Farming*, 1942, Vol. **3**, pp. 378-80.

[2] Rahman, K. A. and Nath, R. *Bull. Ent. Res.* 1940, Vol. **31**, pp. 179-80.

(*Avena sativa*), early maize (*Zea mays*), early fodder crop of *jowar* (*Andropogon sorghum*), shoots of the ratoon and October-planted crop of sugarcane are the main carriers of the pest from the preceding years' crop of sugarcane to that of the succeeding year. It is on these crops that Pyrilla completes its first brood from April to June before it infests the plant crop in July, because by May and June the plant crop will not have developed sufficient foliage to provide shelter to Pyrilla from the effects of hot winds. The shoots of the ratoon and the October-planted crop are its first preference.

Nature and effect of attack

Pyrilla nymphs congregate in clusters on the underside of the leaves and make minute punctures with their piercing mouth-parts with which they suck the sap from the leaf tissues. In case of severe Pyrilla attack, a film of honey-like substance is deposited on the surface of the green leaves. It is on this honey dew that fungi, mainly the sooty mould, develop and form a black incrustation on the leaves, which interferes with the photosynthetic activity of the leaves.

On account of the feeding by innumerable nymphs and adults of Pyrilla, some of the leaves dry up, with the result that the growth of cane is adversely affected and subsequently the yield. The sucrose content of the juice is lowered by 2 per cent to 5 per cent and the purity by 5 per cent to 12 per cent. This deterioration in the quality of the cane had its effect in lowering the sugar recoveries from 0·2 per cent to 5 per cent below normal in the different sugar mills of the western United Provinces during the season 1937-38. The production of *gur* dropped by 2·25 per cent to 4·5 per cent below normal and the quality was inferior and fetched a lower price in the market. Where the intensity of attack was high, well-set *gur* could not be prepared, *rala*, a semi-solid substance of bad colour and taste, was all that could be made. When sugar was prepared by the indigenous *khandsari* method, the recovery of sugar from Pyrilla-infested cane decreased by one and a half per cent from the normal 5·5 per cent.

The germination capacity of the eye-buds from Pyrilla-infested cane when used for seed purposes was much below the normal.

Causes of severe Pyrilla outbreaks

A careful analysis of the meteorological data in relation to fluctuations of Pyrilla-infestation extending over several years has confirmed the findings of Mathur and Gupta[3]. The pest may be expected to assume epidemic form mainly under the following circumstances :

(1) If during May and June, easterly winds predominate and the mean atmospheric humidity is about 50 per cent, as compared to the normal of 25 per cent to 35 per cent, the Pyrilla nymphs will thrive and escape the usual destructive effect of the hot and dry winds.

(2) Intermittent periods of drought occur during the monsoon months of July, August and September and accelerate the multiplication of Pyrilla. Such dry periods varying from seven to sixteen days were observed in July, August and September during the Pyrilla epidemics of 1934-35 and 1937-38.

Other factors

In spite of a wide distribution of Pyrilla in the sugarcane tract of the western United Provinces, considerable variations in the intensity of attack were noticed from place to place. This appears to be influenced by factors other than climatic as detailed below :

(1) Variations in the intensity of attack were observed in different varieties on account of differences in their vegetative characters. Pyrilla attack was noted to be lighter in varieties having narrow leaves with erect or semi-erect blades and, tight or self-shedding leaf-sheaths, as in varieties Co.173, Co.313 and Co. 434.

(2) Infestation is generally higher in fields where heavy manuring and a large number of irrigations are given, promoting sappy and luxuriant growth. This confirms Mathur's[4] observation that a large number of eggs are deposited by Pyrilla where heavy doses of nitrogen are given to the cane crop.

(3) Continuity of Pyrilla from year to year is mostly maintained through the ratoon crops. Pyrilla, which is shade-loving insect, infests ratoons during the hot weather of April, May and June when plant crop has not developed sufficient foliage. Later in the season, plant crop with more sappy and luxuriant foliage is

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[3] Mathur, R. N. and Gupta, B. D. Proc. 9th Ann. Convention Sugar Tech. Assoc., 1940, pp. 1–10.

[4] Mathur, R. N. Proc. 10th Ann. Con. Sugar Tech. Assoc. 1941, pp. 40-41.

preferred resulting in a heavier infestation on it than on the ratoons.

(4) Lodging intensifies the damage as the lodged crop affords better shelter to nymphs and adults. The same is true of the crop where the canes are tied together to prevent lodging.

(5) The effect of frost is more severely felt by crops which are damaged by Pyrilla, as the few top leaves which sustain the plant in the badly attacked crop get dried up on account of frost. This dried up appearance of the crop was a special feature in the badly affected areas of the western United Provinces in the epidemic years of 1935 and 1938.

Control measures

The following measures have been tested and found effective in minimizing Pyrilla attack.

Disposal of cane trash and removal of sprouts from stubble: All the cane trash should be removed from the field after harvest and utilized for composting. If this is not possible, it should be burnt. The fire should be started from all the sides at the same time so that the trash burns inwards, preventing the hoppers from escaping into neighbouring fields. This operation should be carried out up to the middle of March in order to destroy the unhatched egg-masses and over-wintering nymphs. The cane shoots which spring up during February and March from old stools of the harvested crop should be cut off at ground level at fortnightly intervals and fed to cattle until the fields are ploughed up. This removal of shoots should be carried out only once, at the end of April, in fields meant for ratooning. This has not been found to interfere materially with the quality and yield of the ratoon crop in the western districts of the United Provinces. The operation removes all the egg-masses deposited during the month of April and little egg-laying takes place in these fields during the first fortnight of May as the shoots are not big enough. This procedure assures a good ratoon crop in addition to bringing about the control of Pyrilla without any extra cost to the cultivator, who also gets free fodder for his cattle at a time when fodder is not readily available.

Bagging of adults with hand nets: Bagging of Pyrilla adults and nymphs has been found to be a very effective measure during the pre-monsoon period provided it is carried out simultaneously by all the cultivators of an infested locality. Hand nets made of muslin or other light cotton cloth get worn out within a few hours of work. The hand nets for control of Pyrilla in sugarcane fields should be made of thick cloth, preferably with iron or cane rings.

Bagging with hand nets can also be adopted with success for the control of Pyrilla in October-planted crops up to the middle of June. Bagging on such crops should be carried out during the hot hours of the day when Pyrilla adults take shelter among the lower leaves of the plants. The hand nets should be used between the cane rows and the insects that get into the bags should be emptied in kerosine-water (one chatak kerosine in one seer of water) where they are killed instantaneously. A heavy population of Pyrilla adults was reduced in this way to an ineffective number in the October-planted crop at Muzaffarnagar in June, 1942. Six labourers working for about six hours each day from 10 a.m. to 4 p.m. were able to clean up one acre of sugarcane in four days. They bagged about 15,00,000 individuals by putting in 144 units of work (one unit = work of one man in one hour) costing Rs. 4-8 per acre.

Destruction of egg-masses: During April-May Pyrilla adults are confined to the sprouts of the stubble meant for ratooning or waiting to be ploughed up. It is particularly on the underside of the two lowermost leaves of the shoots that the eggs of the first brood are mostly deposited during these months. The egg-masses can be easily spotted as they are covered with white waxy threads. When the under surface of the two lowermost leaves gets entirely covered over with eggs, the upper leaves adjacent to them are used for the purpose. This peculiar habit of egg-deposition during April and May can be easily and effectively exploited for checking further multiplication of the pest in the following ways.

Boys are trained to remove only the two lowermost leaves of the shoots bearing the egg-masses. In cases where there are very few egg-masses the eggs may be crushed by hand and the leaves allowed to remain on the plants for further egg-deposition, to be removed later when the number of egg-masses on them has increased. In this way at Muzaffarnagar during April and May, 1938, ten boys could easily clip the infested leaves over an acre in one day at an approximate cost of Rs. 1-8 per acre per round. At present this operation would cost about Rs. 5 to Rs. 6 per acre per round in view of the increased wages. The operation should be repeated twice during the second fortnight of April and once during the first week of May. The leaves removed will dry up after a time, when they can be easily burnt.

Stripping of dry leaves : During rains when cane grows rapidly and thereafter, the bagging of adults and nymphs or the destruction of egg-masses is not feasible. From August onwards the lower leaves of the cane dry up and leaf sheaths get slightly detached from the stem. As it is on the under-side of these leaf sheaths that the eggs are mostly deposited, it serves to strip off these leaves and remove them from the field. This method of stripping off the dry leaves has been found to be not only praticable but highly effective in the United Provinces.

Stripping can be done by hand, but large-scale operations are best carried out by means of a wooden stripper consisting of a wooden fork of two blades attached to a handle. The handle is about twelve inches long and about one inch in diameter. One end of the handle is flattened to hold the blades which are curved like the blades of a pruning knife. These blades are made of thin strips of wood ten inches long and about a quarter of an inch thick, with sharp edge on the curved side. The operator puts this instrument round the cane and in one downward stroke removes all the dry leaves at their bases. These leaves having been rolled up into bundles are removed to a convenient distance. The best time to strip the crop is when the population of adults is high and the females begin to oviposit. The entire infested area should be stripped off as quickly as possible.

The cost of stripping of dry leaves would depend on the number of strippings carried out and would vary from place to place, depending on the quality of labour and the wages paid. It would also vary with the variety of cane, particularly the nature of the leaf sheath, whether loose or tight, the number of dry leaves per cane at the time of stripping and also the number of canes to be stripped per acre. At Muzaffarnagar during 1942-43, it was worked out that in Co. 312, one stripping in September cost about Rs. 10-8 per acre, a second in October (there being fewer leaves to strip) Rs. 7-12 per acre and a third in November Rs. 3-10. It took 216 units (1 unit = work of one man in one hour) or 24

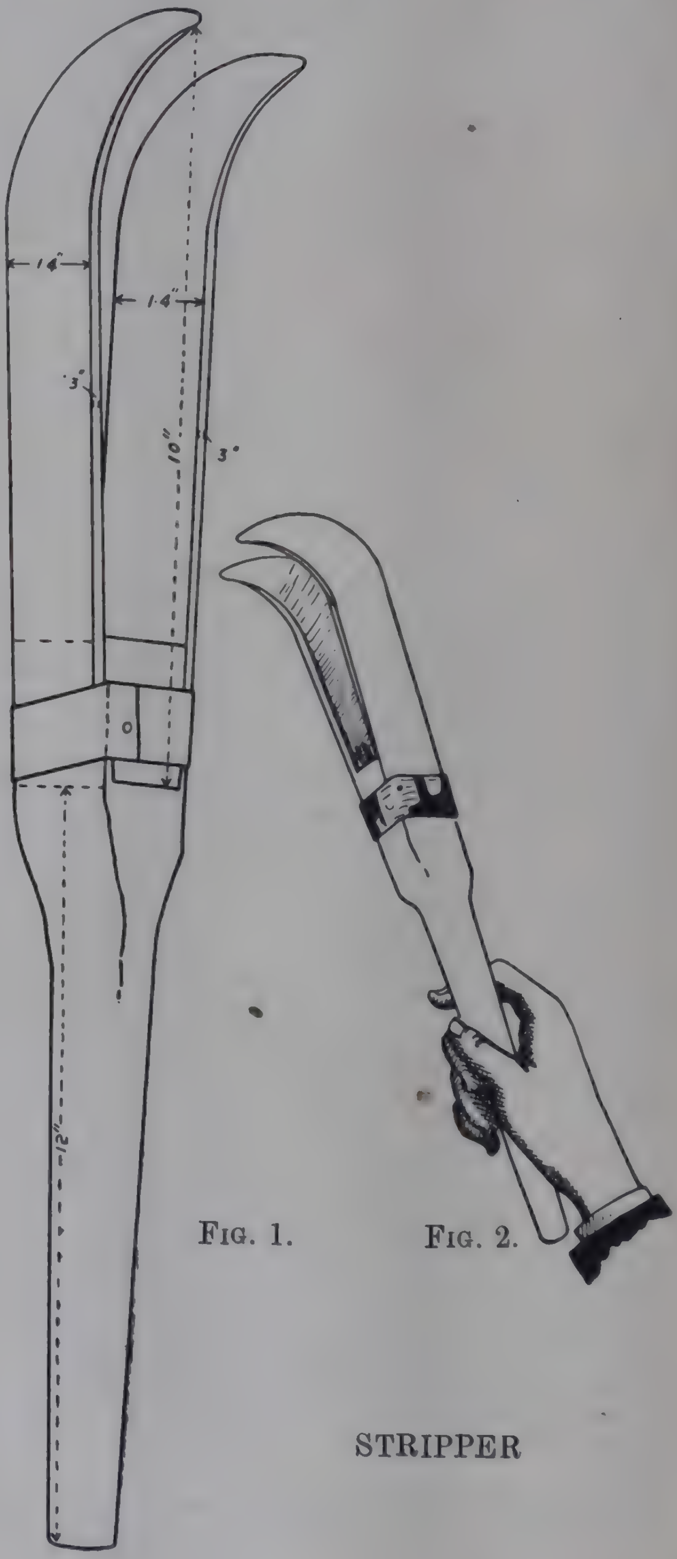

FIG. 1. FIG. 2.

STRIPPER

men working at an average of 9 hours per day to do the first stripping and to remove the dry leaves out of an acre of Co. 312. The second stripping was carried out by 18 men consuming about 162 units per acre in one day. The third stripping of the same variety was carried out by 8 men at a cost of 72 units per acre. In the case of Co. 421 and Co. 453 the cost of the first stripping came to Rs. 9 per acre, involving 180 units of work or 20 men to an acre. The subsequent strippings in October and November were carried out respectively at Rs. 5-12 and Rs. 2-12 per acre, wherein 12 men at a cost of 108 units did the stripping in October and 6 men spending about 54 units finished the work in November.

Benefits of stripping

Apart from the advantages derived from minimizing the attack of leaf hopper, the effect of removing the dry leaves is to allow more light and air to get in the crop. This increases the sugar content of the cane in comparison to unstripped crop. It has been shown that even in non-Pyrilla years, stripped cane is richer in sucrose than the unstripped one. This was confirmed by subsequent observations and shows that the practice is not uneconomical. During a Pyrilla epidemic, the sucrose in juice of stripped cane increased by at least 3 per cent and the purity by 5 per cent. At the Government Farm, Bulandshahr where the crop was stripped during the first fortnight of September, 1937, a steady rise in sucrose and purity was noticeable and the juice analysis data showed that in the month of March the crop had recovered from the bad effects of Pyrilla and the juice quality compared favourably with a non-Pyrilla year.

It was observed after the severe Pyrilla epidemic of 1937-38 that the cane setts from the Pyrilla-infested crop gave poor germination results when used for seed purposes. The germination of eye-buds was more satisfactory from those infested canes where stripping had been carried out early in the season, than from those where dry leaves were not removed in spite of a heavy infestation of Pyrilla.

In non-Pyrilla years the germination of eye-buds from the stripped cane is not so good as it is from the unstripped cane. It was observed that one stripping during August or September was not so harmful to eye-buds as the late stripping during October and November, but more than one stripping was definitely harmful. It is, therefore, necessary that the stripped cane from crop where there has been no Pyrilla attack should not be utilized for seed purposes.

Rahman (*op. cit.*) has pointed out certain draw-backs in the methods of stripping in the Punjab. The experience gained in the United Provinces, however, leads one to think that possibily it is the only practical and efficient method for the control of Pyrilla from September onwards when other methods of control are difficult or impracticable. His arguments against the method as against our experience are :

(1) *High cost of stripping amounting to Rs. 35 to Rs. 44 per acre :* In the United Provinces even with the high rates of wages in 1942-43, the cost of one stripping was not more than Rs. 11 per acre. It went down to Rs. 7-12 and Rs. 3-10 on successive strippings. The Hindustan Sugar Mills Ltd., Golagokrannath (U.P.) carried out large-scale stripping against Pyrilla on Co. 419 and Co. 356, over an area of about 13½ acres in 1942-43 at a cost of Rs. 6 only per acre.

(2) *Damage to eye-buds by frost :* As pointed out above in this note, the germinating capacity of the eye-buds in the United Provinces instead of decreasing actually increased by stripping of the infested cane, because reduction in the number of Pyrilla improved the quality of the plant as a whole and the crop stood the bad effects of frost better.

(3) *Damage to canes by labourers while stripping :* There should be no damage to canes at all if the operation is carried out carefully and properly, particularly with the use of the wooden stripper described above.

(4) *Damage by jackals :* In the United Provinces it has been observed that when only small plots are stripped in a big sugarcane area, the stripped cane attracts the jackals and the damage is concentrated at one place which would otherwise have spread over a much wider area ; but if large areas are stripped the damage by jackal never exceeds 2 to 3 per cent which normally occurs in unstripped crop also.

(5) *Egg-laying takes place on green leaves in the absence of dry leaves :* Observations extending over several years in the United Provinces show

that the egg-laying is considerably reduced in the stripped crop. Whatever eggs are deposited on the green leaves are more exposed to the natural parasitization by the egg parasites than when deposited in the sheltered places on the leaf sheaths.

(6) *Stripped cane lodges badly:* Lodging is more or less a varietal character depending on the conditions of growth. Luxuriant growth on account of heavy manuring and large number of waterings will increase the chances of lodging unless, of course, the variety is highly resistant to lodging, e.g. Co. 453 or the crop has been properly supported by earthing and tying up. The dry leaves almost detach themselves from the stem and do not offer any support against lodging.

Need for organized cooperative efforts

Although the application of these control measures to individual plots will show material improvement, only an organized cooperative effort throughout the affected area can help in getting rid of the pest altogether, as winged Pyrilla adults as well as wingless nymphs are capable of migrating from an untreated to a treated plot.

Acknowledgment

Thanks are due to Dr K. B. Lal, Entomologist to Government, the United Provinces, for scrutinizing the manuscript and giving valuable suggestions.

RICE MAY BE SOWN FROM AIRCRAFT

THE use of aircraft for sowing seed seems likely to be widely adopted in Australia since experiments have shown how much time can be saved when large areas have to be sown.

Both in Queensland and Western Australia, aircraft have been used to sow pastures, and the method has also been used near Tamworth, in New South Wales, for sowing wheat. In this experiment the aircraft flew 40 feet above the ground, and the seed was distributed at the rate of 4 acres to the minute. It is proposed to test the method for sowing rice.

Aerial sowing offers several advantages. Many Australian grain farms are very large. If sowing has been delayed through seasonal conditions, it becomes important for the work to be carried out as quickly as possible, and aerial sowing is a practicable method to use in such cases when the amount of labour and equipment to do the work by other means in a short time may not be available.

It is also possible to complete sowing from the air on land that is too waterlogged for mechanical equipment to be used. In fact, it was the sodden condition of an area in Queensland after heavy rains that led to the first experiment there in aerial sowing, and which indicated the possible value of the method to rice-growers. Rice-growing in Australia is highly mechanized, and the use of heavy machines on land recently irrigated has long been a problem that aerial sowing may help to solve.—*Australian Agricultural Newsletter*, No. AGN/207.

POULTRY-KEEPING IN HOT CLIMATES

By ATHAR ALI and S. G. IYER

ENVIRONMENT influences the growth, production and reproduction of birds perhaps more than of any other animal. Though fowls have been domesticated for several thousands of years, they have still retained many of their original characteristics. They lay only when the conditions are favourable. The natural favourable conditions, however, occur at different times depending upon the climatic factors and food supply which vary in different parts of the world. For instance, the periods of peak production and rest in the Northern and Southern hemispheres occur during exactly opposite months. When in Australia the chickens are in their full production, they moult in the United States of America.

Of all the climatic factors, sun-shine and temperature produce the most profound effects upon poultry, and in those parts of the world where sun-light is limited to certain seasons of the year due to heavy fog, the production is much lowered and artificial lighting becomes necessary in order that the egg-production may be maintained at an efficient level. All classes of poultry should always be protected against sudden and extreme changes in temperature. In very cold climates combs and wattles of both sexes become frost-bitten and egg-production is adversely affected. Nevertheless, specialized poultry-keeping has been found to be quite successful and profitable in almost all the cold countries.

Influence of high temperatures

Birds are ill-adapted to throw off surplus heat on account of feathers and absence of sweat glands. Fowls are therefore more susceptible to high temperatures. They consume more water and eat less food, hence the vitality of the flock is seriously lowered. The temperature undoubtedly influences production, but it is difficult to determine to what extent because of the influence of other factors such as breeding, housing, feeding and management. Some flocks and individuals within a flock continue to lay through extremes of high and low temperatures while others seem more sensitive to climatic changes. Generally the egg size tends to be reduced and the egg shells become thinner and more fragile. The number of abnormal eggs increases and fertility and hatchability are also poorer. Hot dry weather induces broodiness in some breeds. The rate of growth in young stock is seriously retarded. When the temperature in the plains of Northern India is very high the growth of the chickens hatched during April to June is not so well for the first 18 weeks as compared with that of January or February hatched chicks. Poultry-farming during the hot summer months in the plains of India is therefore more difficult than in other seasons. The influence of a very hot day on the subsequent egg-production becomes manifest after three days. The system of early hatching during October and November is being practised in certain specialized farms in the country for the purpose of securing egg-production from pullets during June and July when the older birds are moulting. But rearing of early-hatched chickens requires more careful management than winter-hatched ones.

Atmospheric temperatures between 50°F. to 85°F. are usually suitable for all classes of poultry. According to Australian workers the well-being of the fowl is disturbed when the air temperature rises to high levels. At 90°F. the first sign is drooping of the wings followed by an increase in the number of respirations. Further rise in temperature results in gasps for breath and the so called ' tongue-breathing ' becomes pronounced. High temperatures such as 110°F. can be tolerated by fowls for only very short periods and unless the birds are removed to a cool place, coma sets in followed by death. In one of our experiments adult healthy White Leghorn and Rhode Island Red fowls exposed to direct rays of the sun during noon (shade temperature 112°F.)

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in the month of June, died within half an hour. On extremely hot days if heat prostration is noticed, affected birds should be removed to a cool place and their heads doused. Stimulants such as small quantities of brandy may be administered to the birds if necessary. If trapnesting of layers is practised arrangements should be made to release the birds at frequent intervals. Moderately humid atmosphere in poultry houses during hot weather is more congenial for the fowl than the hot dry atmosphere as the former tends to prevent excessive rises in the temperature of the air inside the poultry house.

Choice of breeds

Every breed has certain advantages and disadvantages and strain within a breed is probably of greater importance than breed itself. In fact only two classes—light breeds and dual purpose breeds—are generally kept in hot climates. Light breeds such as Leghorns and Minorcas are very susceptible to climatic changes particularly during early periods of lay. Rains invariably lower production. The dual purpose breeds are more docile and quiet. Though not so easily disturbed by climatic changes, they are certainly more susceptible to heat. White Leghorn fowls are more resistant to heat and lay much better in hot climates and summer months than Rhode Island Reds, and this is attributed to the compact body, tall legs and white plumage of the Leghorn. Imported breeds often fail to give good results in hot climates on account of difficulties of acclimatization. In India the *desi* birds seem to stand up better to high temperatures than imported breeds partly due perhaps to acclimatization over many generations. Other reasons are the smaller type of bird and the absence of superfluous feathers. During recent years a number of breeders in India have imported pure-bred fowls from Australia and their experience is that the Australian stock do better in India than the stock imported from the United Kingdom or the United States of America.

Hatching and rearing

In cold countries the hatching season ends as summer approaches. To obtain good hatchable eggs in hot climates it is wise to pay particular attention to the management of breeding stock. They should be supplied with liberal quantity of greens so that sufficient nutrients may be available for transmission to the embryo. Though one of the American workers considers it unnecessary to gather eggs oftener than once a day even during hot weather, it is advisable that hatchable eggs are collected several times a day in order to prevent heating. Only fresh eggs should be set or they should be stored in a cool place prior to setting, the ideal temperature being about 60° F. When only a few chickens are raised the simplest method of hatching is under a hen but for larger numbers artificial incubation may be practised. With incubators much of the success depends on the incubator-room which should be cool, well-ventilated and drought-proof.

Successful rearing of young chickens is not very easy in hot climates. The poultry-farmer should aim at securing the optimum rate of growth with a minimum death-rate. Shade is essential, natural leafy shade being superior to artificial shade. Growing shrubs in rearing pens is recommended. Grafted white mulberries also make excellent shade if kept well-pruned. For uniform rate of growth it is important that hoppers and water fountains also are protected from sun.

Mortality

Under satisfactory management chickens can be reared with normal mortality but the reduced stamina of the birds, caused by excessive heat and lesser food consumption, predisposes them to a greater frequency of various diseases causing great losses by way of mortality and lowered egg-production. Caecal coccidiosis is common in warm humid climates and takes a heavy toll of birds up to ten weeks of age. Fowl-pox is very prevalent in India, the mortality being well above 50 per cent. Ranikhet disease has in recent years received more attention than any other poultry disease. It is being reported during all periods of the year. On specialized farms routine vaccination of chickens between 8 and 12 weeks, against fowl-pox and Ranikhet disease is recommended. Tick fever is another disease which is very prevalent in hot climates, its control being exceedingly difficult in places where ticks abound. Parasitic infestations also increase since warm humid atmosphere is conducive to their multiplication and the poultry-keeper has to be constantly watchful

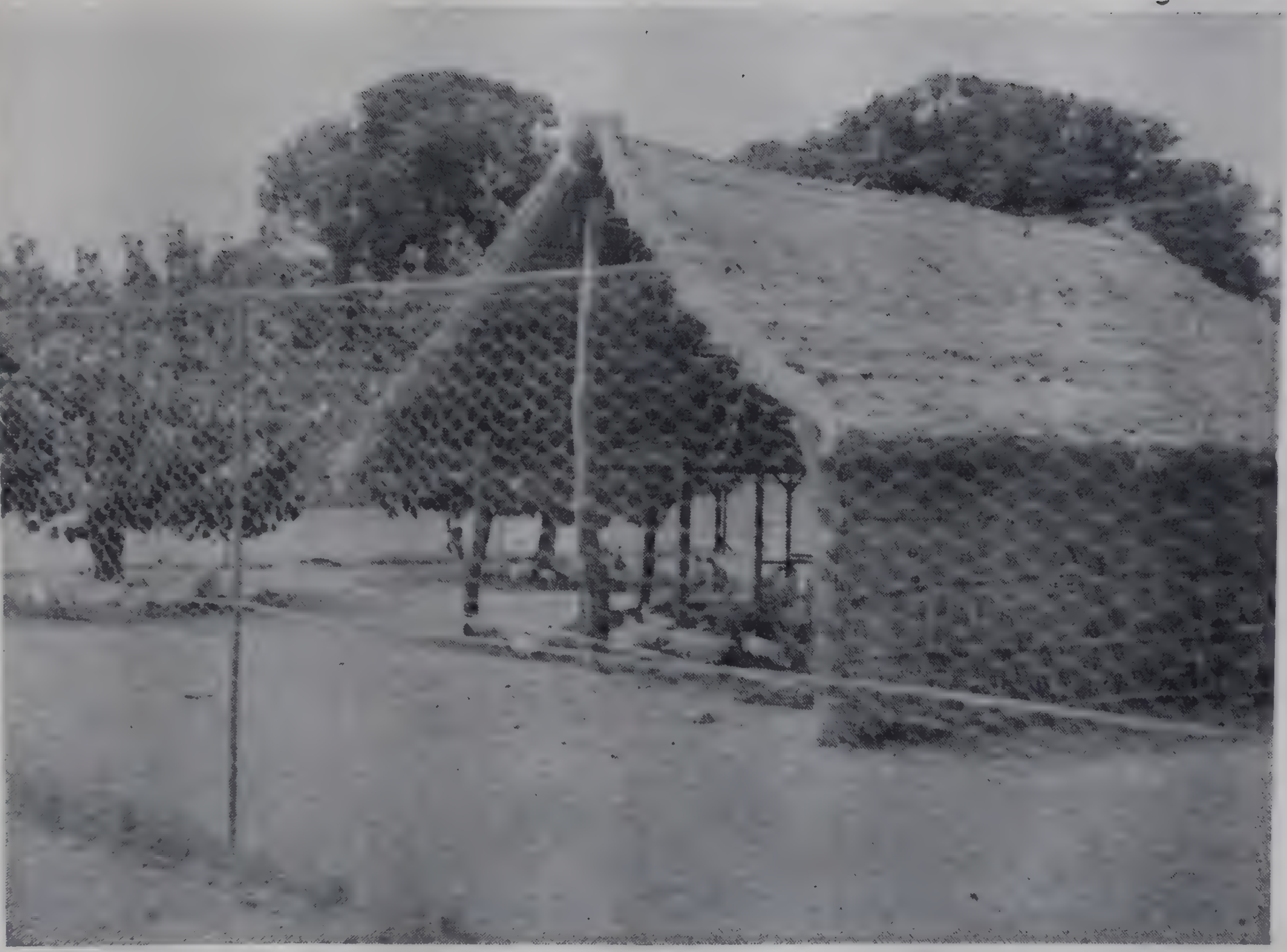

FIG. 1. Angle iron bar-wire netting house under *chappar*.

PLATE 25

to avoid them in his flocks. Outbreaks of seasonal 'colds' are also common where sudden and extreme variations in temperature prevail and the days are hot and nights cool. During summer months due to natural scarcity of green food cases of vitamin-A deficiency may occur, and feather picking is also common. These could be prevented by adding bulk to the rations in the form of wheat bran and feeding green vegetables.

Management of layers

The most important factor in the management of layers is to ensure that the houses are properly ventilated. Lack of ventilation is very harmful. Fowls more than any other animal require plenty of fresh air. If they are kept in permanent houses adequate ventilation should be provided. The inlet and outlet in the poultry house should be set at a fairly low level, in level with the height of the birds. This will ensure a regular exchange of air to maintain uniform temperature. Drought inside the poultry house during hot weather is not very harmful to the birds and it helps to lower the temperature inside the house. If the humidity is very low on excessively hot days the hanging of a wet curtain in front of the door or window tends to lower the temperature of air inside the houses. Water may also be poured to make the floor wet. It is also good to provide wet dust baths in the runs under shade.

Overcrowding results in over-heating and the egg-production is adversely affected. A floor space of 4½ sq. ft. per bird is advisable in the intensive system but in free-range less floor space is required. Perches should be at least 20 in. apart to ensure a current of fresh air between the rows of birds. About eight to nine inches of perch room is necessary for each bird. All perches should be fixed on straight iron rods driven into the ground to give support. To the tops of the iron rods and four inches below the perch, small iron cups should be soldered and they should be filled with kerosene oil. Such perches are proof against insect pests attacking fowls at night. Though solid type of houses with ample ventilation may be used for keeping poultry in hot climates, they are not really necessary on the plains in India. The house should be specially designed to prevent sun's rays falling in and made as dark as possible during the heat of the day. In more temperate climates houses are usually placed facing south with the object of catching the mid-day's sun but in India houses should have the windows facing east or north-east. Fowls can be safely kept in houses made of angle iron covered with wire netting. Protection against the sun and wind can be given by grass-thatched *chappars* (Fig. 1). The wire netting houses are a good safeguard against ticks and quite satisfactory throughout the whole year.

Broodiness in the dual purpose breeds is pronounced and responsible for serious lowering of egg-production in hot climates. If a broody hen is allowed to remain in the nest her natural impulse is prolonged, but if removed to a suitable broody coop and properly looked after, a well-bred hen should be fit to return to her pen in about four days and lay within a fortnight. It is much better if the broodies are systematically caught each morning and placed in a suitable coop with sufficient ventilation from below. The success of poultry-keeping in hot weather depends primarily on one's ability to judiciously cull all boarders and those moulting early or showing a tendency to get too fat as this will reduce food costs and increase profits.

Feeding

Fowls in hot climates actually require less food than in cold climates and often almost lose their appetite during a very hot spell. In such cases the usual quantity should be reduced according to demand or it may be cut totally for a day. It is always preferable to keep the birds keen on their food. Soaked grain instead of dry has been found to be useful.

Careful attention should be paid to watering arrangements. The water should be fresh and cool. The water vessel should be scrupulously clean and placed in shade near the houses so that the birds are not required to traverse long distances for it during the heat of the day. Water may be provided in wide earthen containers (*gamla*) and during hot periods of the day the birds should have free access to douse their heads. It is important to remember that an empty drinking vessel even for only a portion of the day results in serious fall in egg-production. Fowls which are unable to drink their full requirements of water do not consume normal quantity of feed and this is highly detrimental to egg-production.

Little is known regarding the best poultry feeds for hot climates. Though theoretically foods rich in carbohydrates and fats should be avoided, recent investigations show that it is not advantageous to reduce the proportion of grain in the diet for layers, while it is useful to increase the quantity of bulky food like wheat bran. It is good to feed oats where available, for it helps to prevent cannibalism which is very common in hot climates. To obtain maximum economic production the layers should be supplied with approximately 14 per cent of crude protein in their ration.

Vitamin-A is important because its shortage may cause lowered egg-production and outbreaks of nutritional roup ; poultry-farmers in hot climates should therefore make special efforts to supply all classes of birds with good succulent green feed. It should always be fed at a fairly young stage because it loses much of its palatability and nutritive value if left to become hard and woody. Lawn clippings are one of the most valuable green feeds which could be easily procured in certain places. Since greens are always scarce in hot dry climates, the difficulty to a certain extent can be overcome by feeding 30 to 40 per cent yellow maize in the ration.

Care has to be exercised in the purchase of good feeds and in feeding. Careful attention has to be paid to maintain ideal hygiene. Furthermore the methods and practices of the West cannot be copied wholesale but they have to be modified to suit the requirements of hot climate. This needs considerable practical experience without which no amount of academic knowledge or financial investment may be of much avail.

Marketing

The rapid deterioration in egg quality in hot climate increases the difficulties of egg-marketing and it becomes necessary that the egg should be collected from the nest several times daily, stored in a cool and damp place and disposed of as quickly as possible. One of the commonest troubles is the embryo development, which occurs when the air temperature goes above 80°F. In order to prevent this the males should be segregated from the females except when hatching eggs are required, as infertile eggs keep much longer than fertile ones.

The majority of eggs marketed in India are fertile and during summer months their marketing is therefore a major probelm. Loss of eggs remains high and to overcome this difficulty a method has been evolved whereby the fertility in the eggs, which is the primary cause of eggs becoming spoiled, is destroyed and the eggs are rendered as good as infertile ones. Defertilized eggs have been found to keep as well as naturally infertile ones. The process consists of heating the eggs in water maintained at 55°C. for 15 minutes and can be recommended to any poultry-keeper with average skill. The adoption of this method on a countrywide scale, particularly at the egg-collecting stations, is most desirable during the hot weather and would lead to a considerable reduction of losses from germ development. Defertilized eggs can show no germ-growth thereafter. The keeping quality of the defertilized eggs can be considerably improved by preserving them in lime-water and the method will stimulate consumption of eggs.

CULTIVATION OF *DIOSCOREA ALATA* L.

By A. SANKARAM

THE genus Dioscorea embraces two species of economic importance cultivated largely for their edible subterranean tubers. A note written by the author embodying the cultural details and botanical description of one of the species, viz. *Dioscorea esculenta* Burk., was published in the *Madras Agricultural Journal,* March 1943. A similar account of the other species, viz. *Dioscorea alata* L., is presented below.

Dioscorea alata L., belongs to the family Dioscoreaceae. Like other members of the family the plant is a herbaceous annual with twining or procumbent stems bearing large and long subterranean tubers. These are borne two at each root with brown skin and white flesh underneath.

Cultivation procedure

Soils : Sandy loams of high fertility coupled with good drainage are well-adapted for raising this vegetable. However, soils of medium fertility can be rendered suitable by the application of adequate quantities of organic manures. Heavy clayey soils and low-lying lands liable to inundation are definitely unsuitable for the purpose, as drainage is a prior condition in land choice. The desired land tilth is best secured by about 8 to 10 ploughings of the land with a country plough. The ploughed field after manuring is worked up into ridges and furrows 3 ft. apart or squared beds 8 ft. × 8 ft., the latter being more common.

Crop rotation : Local experience of its culture has shown that the crop should not occupy the same ground oftener than once in three years, as neglect of this precaution would result in lower yields and tubers of inferior quality. In crop rotation it follows a vegetable crop like brinjal, Lady's finger or a millet like *ragi.* In the midst of the crop a few plantain suckers and sets of tapioca all round the field are planted.

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Manures and manuring : The crop shows marked response to good manuring and heavy manuring is regarded to give economic yields. Ten tons of farmyard manure per acre is ordinarily required to obtain an average crop. Any deficit to this level is met by sheep penning. In addition, application of green-leaf manure (wild indigo) at the rate of five tons per acre is common with some of the growers.

Seed material and planting : The seed material consists of well-developed and healthy tubers selected from a previous crop during March-April. The selected tubers are stored under a cool, thatched shed, turned occasionally and all sprouts are removed. As the interval between planting and harvest is usually short, some growers follow the practice of setting apart a portion of well-grown field (8 to 10 cents) for purposes of seed material. Planting of the crop usually takes place during April under artificial irrigation. Where water is no limiting factor, planting is done in March to capture an early market. Nine-inch lengths of the tubers are planted at 18 to 24 in. apart either way on beds. About 1,250 lb. of tubers go to plant an acre of the field.

Irrigation : Maximum production calls for copious watering coupled with good drainage. During normal seasons of well-distributed rainfall fifteen irrigations are required to obtain a bumper harvest; but failure of timely rains increase the number of irrigations to more than eighteen.

After care : Seeds begin to germinate in about fifteen days after planting and in about six weeks the vines need propping. At the centre of a set of four vines each arising from one tuber a strong bamboo is planted and the set of four vines is trailed on to it. A fortnight after planting the plot is weeded and a week later the first hoeing is given. A second hoeing follows a month later.

Harvest : The crop matures in about eight to nine months from the date of planting. The maturity of the crop is indicated by the cessation of all vegetative development and change of colour of the leaves from green to yellow admixed with red. Some leaves begin to drop off. At this stage the tubers are lifted by completely digging around them with a crow bar. The harvested tubers are collected and dried in the shade and the adhering soil removed. The roots of the tubers are then scrapped off with a knife and they are thus rendered fit for sale in the local markets and *shandies.*

Yield and marketing

The yield is chiefly conditioned by the nature of soil, season, manuring, irrigation and the care with which the crop is cultured. An average crop in the neighbourhood of Anakapalli (Vizagapatam District) is known to yield 10,000 lb. of marketable tubers. Still higher yields are not uncommon.

Economics of cultivation

The cost of cultivation as detailed below comes to Rs. 440 per acre. Taking the average crop yield to be 10,000 lb. valued at Rs. 0-1-0 per lb. the gross income from an acre of the crop would be Rs. 625 and the gain will be Rs. 185 per acre. An additional income of Rs. 15 from the inter-crop of plantains has to be added to it making a total gain of Rs. 200 per acre. The details of cost are given below:

	Rs.	as.	p.
Preparatory cultivation ..	25	0	0
Manures and manuring ..	40	0	0
Seed material and planting ..	82	8	0
Irrigation	105	0	0
After care, weeding, hoeing, etc. ..	42	8	0
Propping the crop with bamboos ..	110	0	0
Harvesting and cleaning ..	32	8	0
Assessment of the land ..	2	8	0
Total cost of cultivation ..	440	0	0
10,000 lb. of tubers valued at Rs. 0-1-0 per lb.	625	0	0
Additional income from inter-crop of plantains	15	0	0
Total net gain per acre ..	200	0	0

Conclusion

It is not surprising that this crop ranks high among other vegetables and is preferred by market gardeners to other root crops as the net profits from this are distinctly encouraging. The average holding of a ryot in respect of this crop ranges from 40 to 60 cents, so as to keep the cash expenditure at its minimum and maximize net gains. A plea to increase its production is warranted during a time when production of vegetables has become a vital need all over the country. Being a cheap and yet an extremely delicious root vegetable, *Dioscorea alata* L. deserves extension of its culture in all suitable localities of the country.

> Five principles of farming are good texture, good time for sowing, good moisture, manure and the best seed.
> —*Agricultural aphorism from Deccan.*

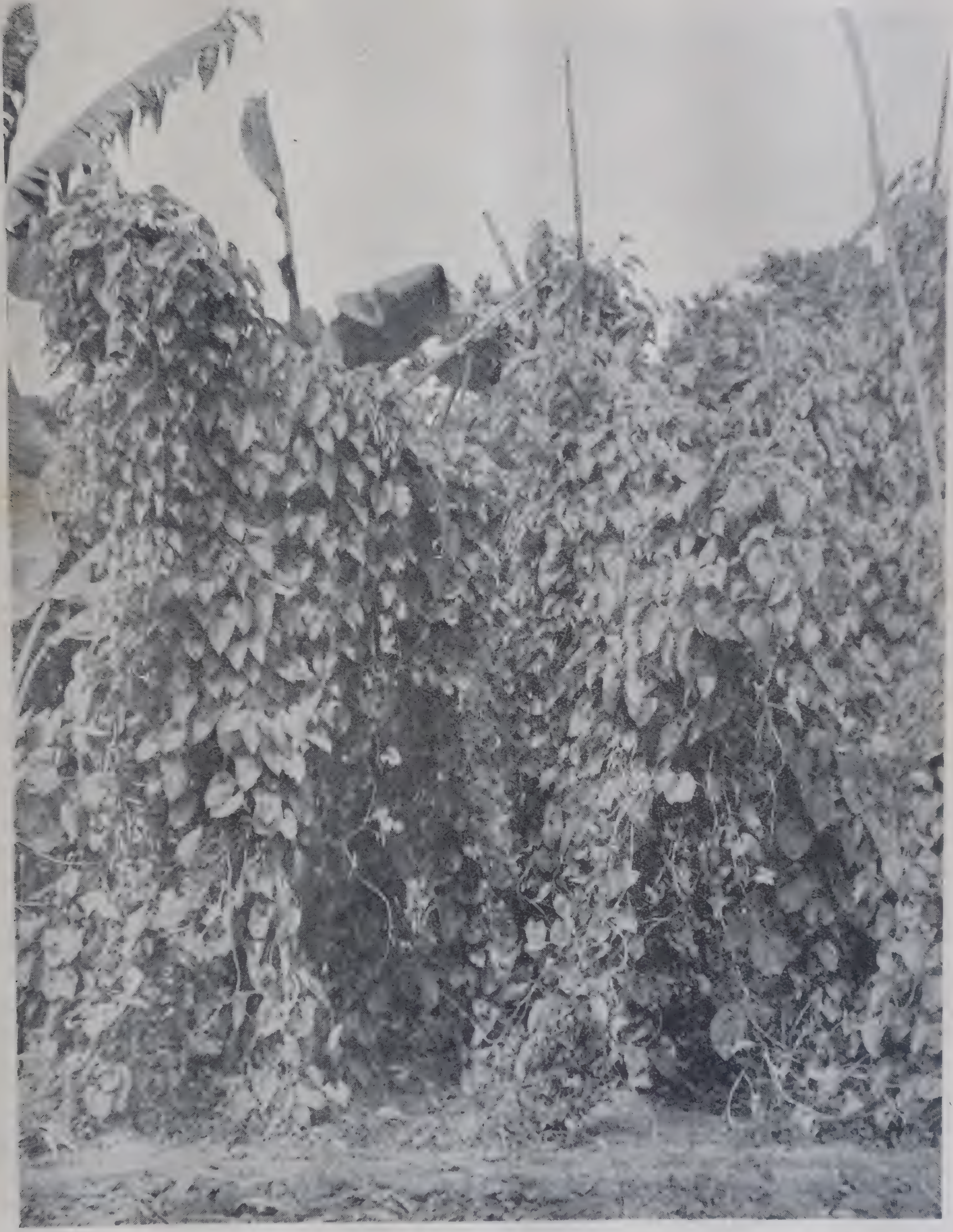

FIG. 1. Field crop of *Dioscorea alata* L.

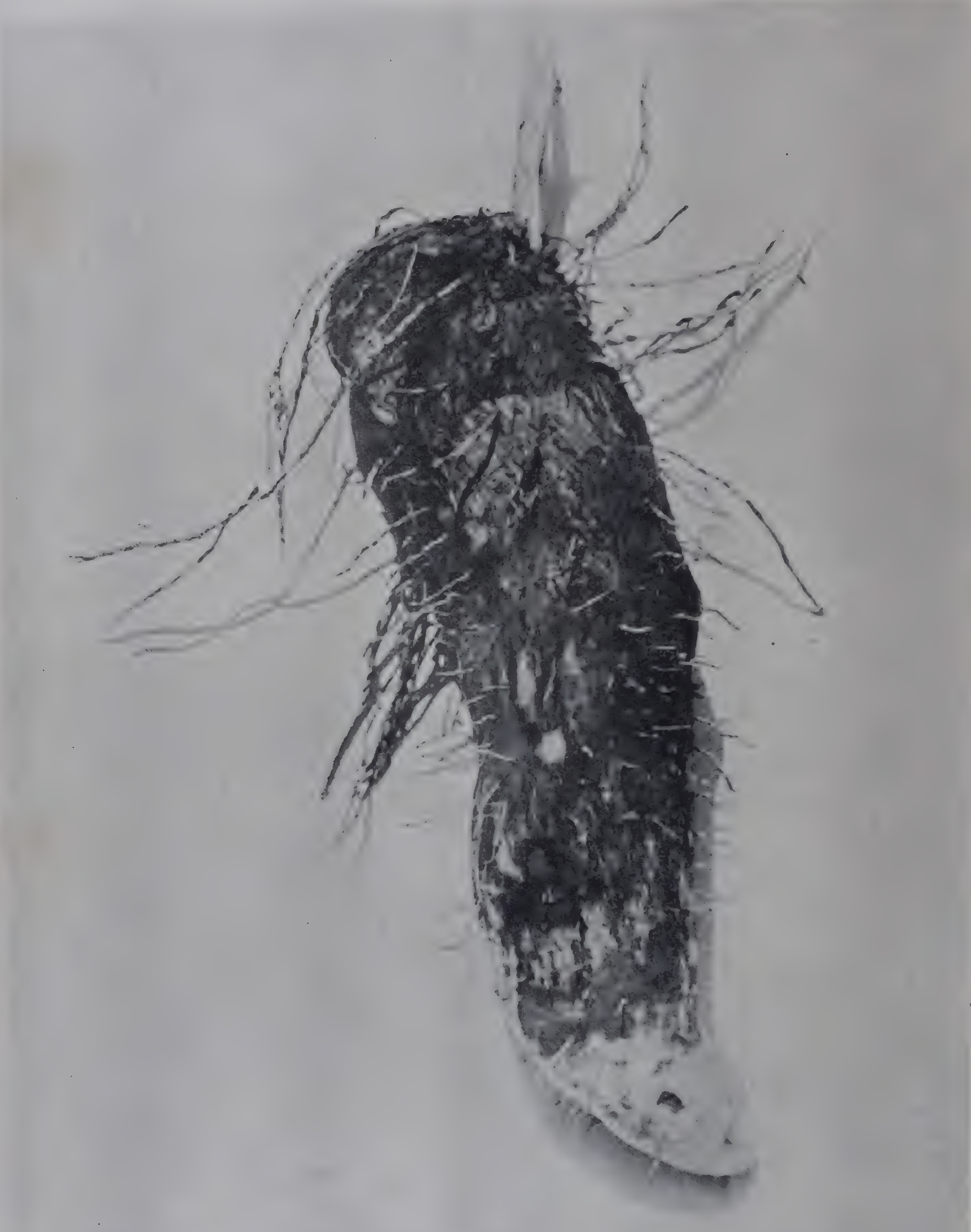

FIG. 2. Root tuber of *Dioscorea alata* L.

PLATE 27

JUTE CULTIVATION IN BIHAR

By ADYA CHARAN SINHA

JUTE and its cloth are mentioned in ancient Sanskrit writings but were not known in other parts of the world till late in the 18th century when the East India Company interested itself in its trade. This gave an impetus to the handloom industry and during 1850-60 this was considered the principal industry of Bengal. With the establishment of power looms this industry has gradually died out and exists as cottage industry to meet local domestic needs in certain parts.

Jute or *pat*, as commonly called in Bihar, is an important crop of Bengal, parts of Bihar and Assam. Some jute is also grown in Orissa, sub-montane areas of the United Provinces and Madras Province. In Bihar jute cultivation is limited to the districts of Purnea, Saharsa, Bhagalpur, Santhal Parganas, Champaran, Muzaffarpur and Darbhanga but over 90 per cent of the acreage is confined to Purnea District. Out of the total jute produced in Bengal about two-third is grown in East Bengal. The part of the Sylhet District in Assam which has acceded to East Bengal has considerable acreage under jute. With the division of the country about 72 per cent of the jute acreage in this sub-continent is located in Pakistan and almost all the looms in India. Unless the jute fibre is imported from Pakistan many mills in India will have to be closed down. Further to establish world economy it will be necessary to export raw fibre and finished jute products. As there is heavy demand for producing more food to meet the present shortage it will not be desirable to increase the acreage under jute considerably. The only alternative is either to produce more raw jute per unit of land or continue importing raw jute to the country's economic detriment. Increase in production can be achieved by using improved seeds and practising improved methods of cultivation.

Scope of jute cultivation in Bihar

Since the division of the country the importance of jute as a cash crop in the Indian Union has increased tremendously. The Purnea District of Bihar with its favourable climate and easy availability of retting water has enormous scope for meeting the national and international demand for raw jute. The area under jute crop in Purnea District in recent year has gone down from 3,62,000 acres in 1936 to 1,44,200 in 1947.

The reason for this drop in production is mainly due to increased intensive propaganda under ' grow more food ' campaign and partly due to the relatively poorer prices prevailing for jute as compared with food crops. If only the area previously under jute is again put under this crop, the production will increase by over 100 per cent. Since it is not advisable to grow cash crops on lands meant for food crops, the increase in the acreage and production of jute can be effected by the following ways :

1. Bringing the culturable waste lands under jute for the first year. The low lands liable to early flooding may as well be put under jute. At present most of these lands are left uncultivated from year to year. The sugarcane lands which are left fallow during the *kharif* season can be utilized for growing green Olitorius variety provided sources for retting are available. The fallen leaves of these plants will add humus to the soil thus benefiting the land.

2. At present the cultivators as a rule do not apply any manure to low-land Capsularis jute crop but add a little of manure to upland jute crops. Adoption of proper method of cultivation and use of manures and fertilizers, as recommended elsewhere, will increase the yield by at least 30 per cent.

If all these sources are properly tapped and manuring done there is no doubt that with the increased production it will not only be possible to meet the demands of our mills for raw materials but we shall be able to export considerable quantities and thus add to our dollar resources. It will not be out of place to mention here that cultivation of jute on low lands is only possible where early rains set

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in or facilities are available for the supply of cheap water for irrigation purposes. In North Bihar except Chapra District, there are places in the north and north-east where climate and other factors are quite suitable for jute cultivation. To encourage jute cultivation in North Bihar, it is necessary that arrangements for cheap water supply for irrigation to counteract the failure of early rains be made. Most of the low-lying paddy areas can be utilized for growing jute. With the availability of irrigation water jute cultivation in North Bihar can easily be increased by about ten lac acres. In South Bihar, particularly in Santhal Parganas and Chotanagpur areas, there is scope for increasing the cultivation of jute.

Imported varieties of jute seeds were first introduced in Purnea District by Mr. Jackson, Agent, Rally Bros. in 1906. He brought seeds of a variety known as *Desual Serajganj* (*capsularis* type). This spread for about two to three years and was very similar to the local variety but was more vigorous and higher yielder having red stalks.

In later years Mr. Williams, Manager, Birnagar Concern and Kajha Indigo Concern, got seed of *Kakaya Bombaia* (*capsularis* variety) from Narainganj and distributed in this locality.

Credit for first introducing green *olitorius* to Purnea goes to Mr. F. Y. Crow who got a small sample from Mr. Finlow of Dacca during 1915-16.

Distribution

In Purnea District jute is most extensively grown in the north and north-east in the Kishanganj Sub-division; Araria Thana in the north-west; Sikty, Palasy and Forbesganj in the eastern portions of Araria Sub-division; and Kadwa, Barsoi and Azamnagar Thanas in the south-east. Dharampur Pargana also grows a variety, locally called *channi*, imported at Sarsi by Mr. F. Y. Crow. In Calcutta markets it is known as *mestapat*; its fibre is white silvery and shining. The yield is also better than the local variety. The local variety of the District now consists of mixture of all the varieties introduced in the District. *Mestapat* fetches high price. It takes about seven months for this variety to mature. The rotation commonly followed with *channi* is oats and barley.

Jute belongs to the natural order Tiliacea and the following two species are most commonly grown in Purnea District:

(i) *Corchorus capsularis*
(ii) *Corchorus olitorius*

The characteristics of the two species are given below.

C. capsularis: Leaf contains a bitter glucoid, and tastes bitter on chewing; often known as bitter *pat*; seed pod roughly globular; seeds bigger and copper-coloured; fibre ordinarily white; may be sown any time after February; earlier sowings give stunted growth; yield of fibre less; harvested in July; matures in 4 to 4½ months; can be grown on lands which will retain moisture when ploughed in January and February; ordinarily meant for lands liable to early flooding.

C. olitorius: Almost tasteless when chewed; often known as sweet *pat*; destroyed by cattle; leaf has a rougher under-surface; seed pod cylindrical; seeds smaller and grey, green to bluish in colour and get black in wild state; bluish, green-coloured seeds give best results; fibre frequently finer, softer, stronger, and more lustrous; colour of fibre yellowish, reddish or greyish; flowers larger and of deep yellow colour; tends to grow taller; may be sown after March after first shower up to June; best results obtained when sown in April or May; generally sown on uplands; cannot thrive in water-logged conditions; superior in spinning qualities; harvested in August; matures in 5 to 5½ months.

Out of the total jute acreage about 60 per cent is under *capsularis* variety. This variety has the advantage over *olitorius* in that it can be sown on low lands that are liable to be flooded early in the season and on which transplanted paddy can also be grown after jute harvest.

The most widely used and recommended varieties of the *capsularis* and *olitorius* species are Dacca 154 and green Olitorius respectively. The former is known locally as *Dacca Bombai or Kakaya Bombai or Sada* and the latter *Muniasi*, *Sonabang* or *Tossa*.

Climate

Jute is a *zaid* and *kharif*, i.e. summer and rainy season crop. It requires damp, heat and very regular rainfall during growing seasons. The low-land jute sown in March has mainly

PLATE 28

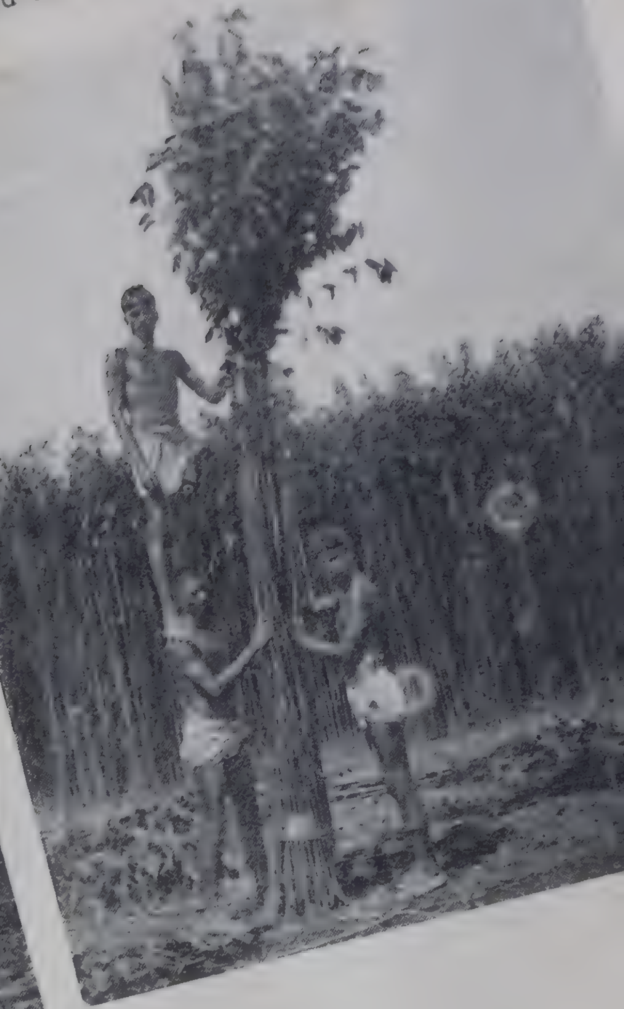
FIG. 1. A good crop of jute.

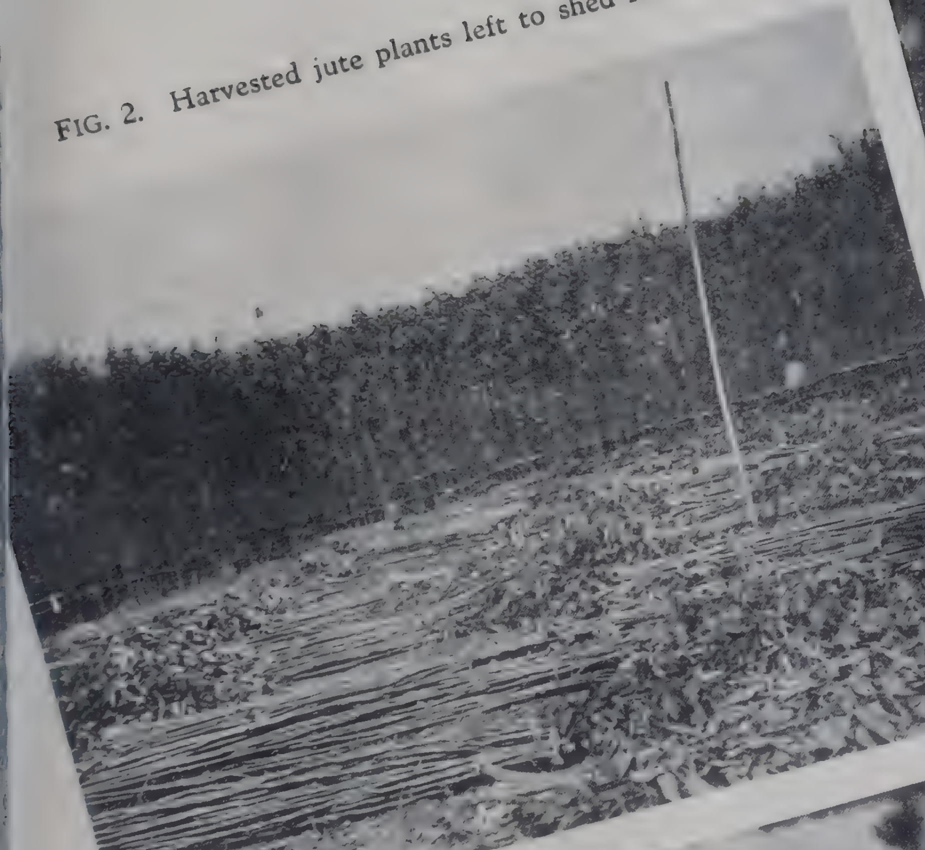
FIG. 2. Harvested jute plants left to shed leaves.

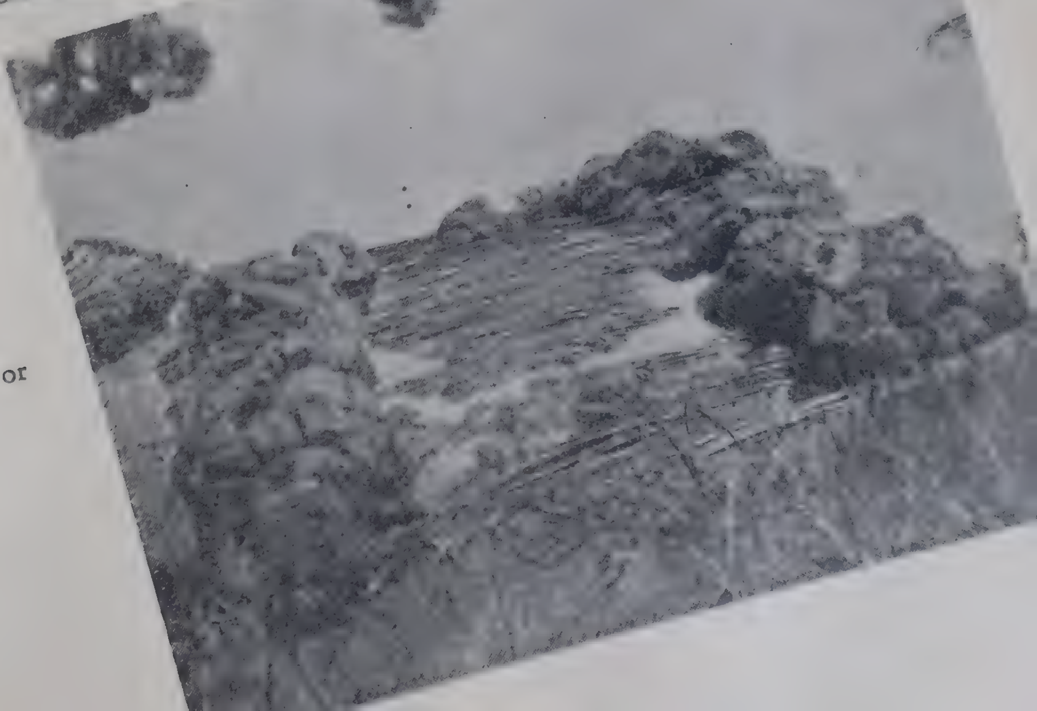
IG. 3. Jute stems ready for steeping or retting.

FIG. 4.

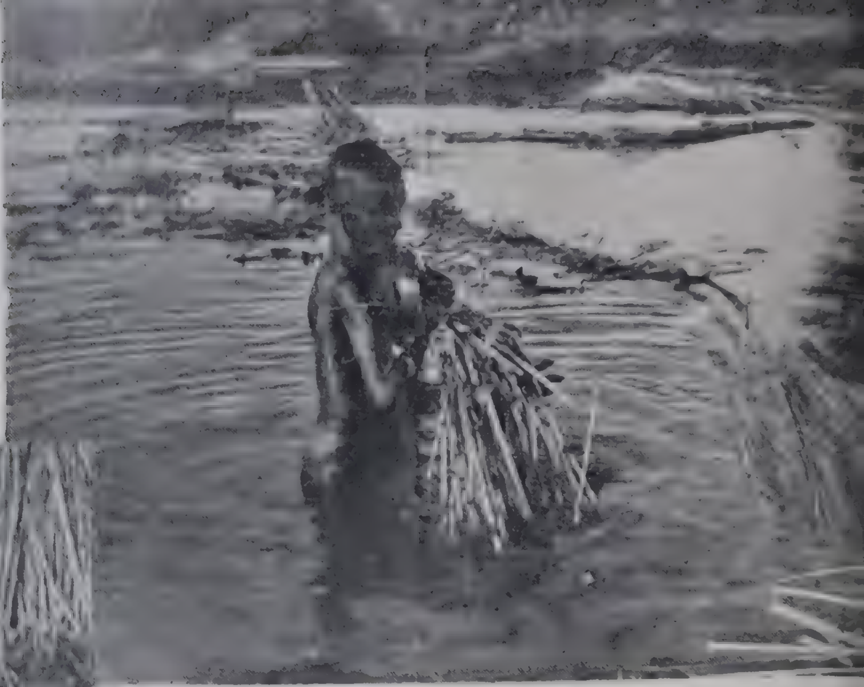

FIG. 5.

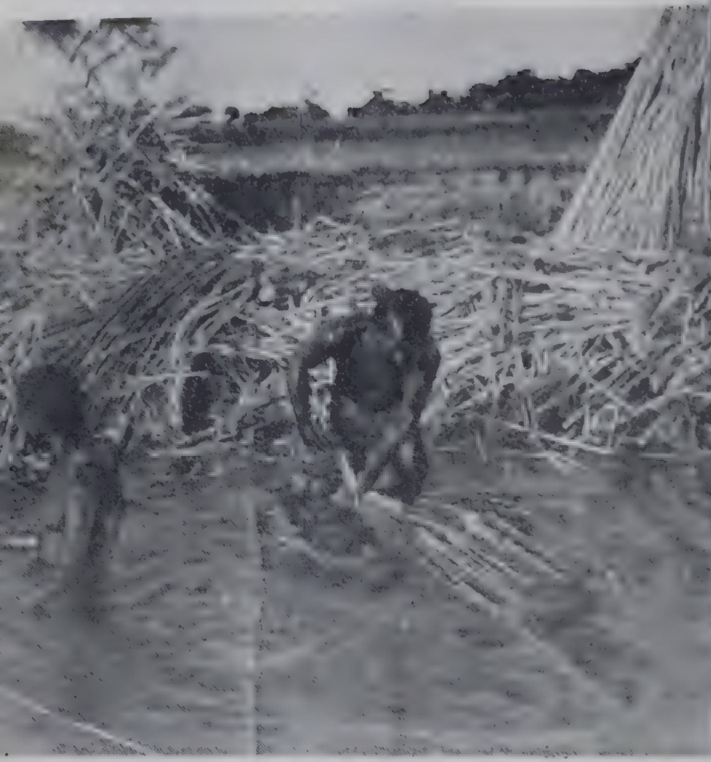

FIG. 6.

. 4. 5 and 6. Stripping and washing jute fibre.

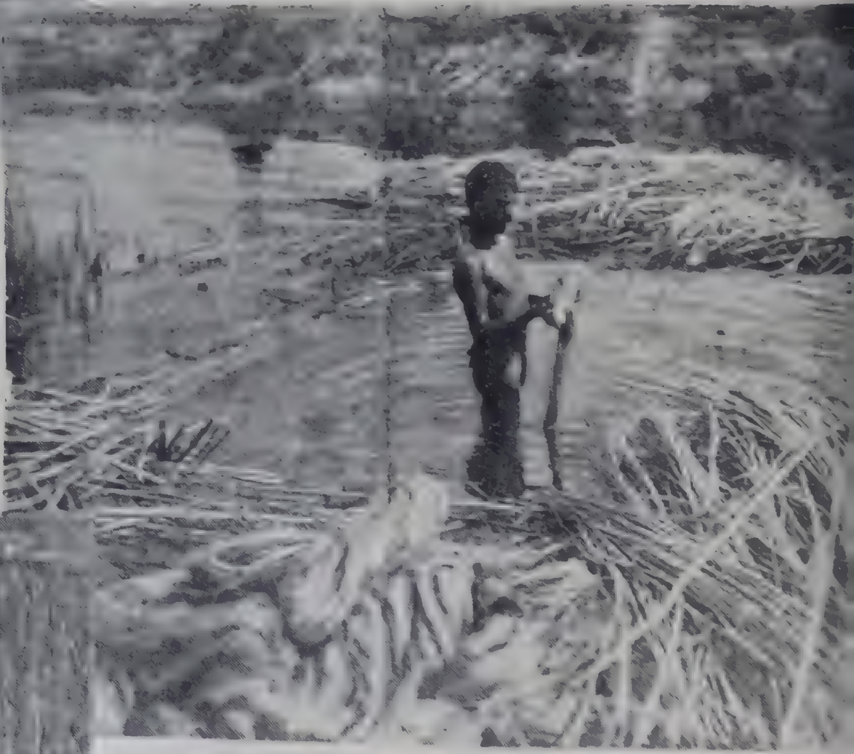

FIG. 7. Drying of jute fibre.

to depend for its water requirements on the sub-soil water and north-western showers. The low-land jute is sown later in Purnea District than in other provinces as pre-monsoon rain during February and March is often not enough. *Capsularis* can stand stagnant water up to two to three feet, but if plants are allowed to stand in water fibrous roots develop deteriorating the yield and quality, and the growth is permanently checked. A rainfall of two to three inches before sowing and about an inch or two each week during growing period is very beneficial. An alternate period of sunshine and rain is desirable.

Soils

The soil of this District is alluvial and its character is determined by the rivers. The eastern portion of the District is intersected by rivers and water channels and contains numerous marshes, and has a loamy soil rich in alluvial deposit. The principal crop of this locality is jute. In general any land having alluvial soil and suitable for paddy will grow jute. Clayey loams that will conserve moisture when ploughed in January and February are best suited for *capsularis* but sandy loams are preferable for *olitorius.*

Manuring

In the local practice no manure or very little cow-dung and ashes are applied to jute crop. On the other hand the cultivators believe that any crop grown on the land which has been previously cropped with jute gives better yield. This is because the jute crop while ripening shed leaves which make valuable manure.

The jute land may be green-manured or hundred maunds of cow-dung manure and five maunds of ashes per acre may be added. Five maunds of oilcakes or one and half maunds of ammonium sulphate per acre have also given good results. Decomposed cow-dung may be added before sowing and oilcakes about a fortnight before sowing. It is preferable to give ammonium sulphate in two doses, one just before sowing and the other after first weeding. Addition of about five maunds of ashes is essential.

Preparation of land

As the jute seeds are rather small a fine seed bed is essential. The general preparation of land for all kinds of jute crop begins in mid-winter and finishes by February for lowlands and by April for upland. Two ploughings and cross-ploughings with Bihar Plough and cultivating twice with Bihar Cultivator or eight ploughings and cross-ploughings with country plough has been found very satisfactory. The land should be laddered after each ploughing. When sowing is contemplated the next day the land should be left laddered over-night.

Rotation

The following rotation should be adhered to:

Capsularis: One year—Jute-early paddy (short duration paddy)—gram or *khesari.*

Olitorius: One year (i) Jute—wheat, or mustard or pea or gram (ii) Jute-paddy and *pyra.*

Sowing and seed rate

As the seeds of *olitorius* varieties are smaller so the seed rate is less than that of *capsularis.* The land should be harrowed and *capsularis* seeds at the rate of 4½ seers and *olitorius* seeds at the rate of 3 seers per acre should be broadcast first from east to west and then from north to south. The land may then be laddered. The germination will ordinarily take place in three to four days. Complete germination will take about a week.

Inter-cultivation

Weeding and thinning of the crop is very important else the yield is adversely affected. As soon as the plants become three to four inches tall the field should be harrowed with a rake, *bidha*, *parsa* or a peg harrow. It will destroy the young weeds and break up the crust. If necessary the crop should be thinned to about six inches. The weeds should be kept down by hand-weeding with a *khurpi* two times. Care should be taken that only weak and below-the-average plants are removed. It should be borne in mind that fibre of finer texture and free from roots are only obtained from plants closely spaced, and cylindrical in thickness. Wider spacing induces branching and thickness of the plants thus lowering the quality. If inter-cultural operations are done properly the plants will attain a good size of ten to fifteen feet (*capsularis* 10 to 12 feet and *olitorius* 12 to 15 feet).

Harvesting

The best stage of harvesting the plants is when they start flowering and pod formation commences; *capsularis* variety is ready for harvest in about July or August and *olitorious* in September or October. If harvesting is done before time the yield is poor and if late, the fibre is course. The plants should be cut with a sickle close to the ground and above the roots. If the plants are submerged in water it is better to pull them out. After-harvest they are left in the field for three to four days for leaves to shed. The plants are then bundled; good results are obtained when bundles are not very thick and are of about eight inches diameter. The bundles are then carted to a tank, ditch or river. It is better to select such land where suitable water for retting is available.

Retting or steeping

Retting consists in the separation of the fibre strands from the central woody portion by the disintegration of all the intervening soft tissues in which the fibres are embedded. It is the biggest factor on which the quailty of the fibre depends. Gently flowing, fairly deep (5 to 6 feet), clear, soft, and tepid water is most suited for the purpose. In rapidly running or salt water more time is required for retting. The time for retting depends on the above factors together with the state of maturity of the plants; about fifteen days will be required in August and September; twenty days in October and twenty-five days in November depending on the temperature of the retting water. The bundle should be immersed in water and tied with heavy logs of wood, brick or stone so that they may not float. Bundles should not be steeped in muddy water or weighted down with clods of earth else the colour will be affected. The thinner portions of the stem get retted earlier and the thicker portions take longer time. As over-retting spoils the quality of the fibre, the importance of growing uniform crop cannot be over-stressed. It is best if root ends are first steeped for two to three days before steeping the whole plants. Retting is considered as complete when the fibre separates easily from the pith or woody portion of the stalks; for this the bundles should be examined occasionally during retting. Some cultivators instead of putting the plants for retting directly on the soil, prefer to put a bedding of *Bhadai* paddy straw and put the bundles in the water for retting.

Stripping or washing

Stripping is the process of removing the fibre from the wood of the stalk. When retting is complete the bundles are either taken to shallow water or brought out on the land. They are then distributed in several lots of eight or ten plants. The labourer then stands in shallow water of two to three feet deep and holding the bundles in left hand beats the root ends with a wooden mallet. Root ends when crushed are broken about one foot in length and the loosened ends are wrapped round the fingers and stems, jerked forward and backward till the fibre completely separates from the wood. The sticks are then thrown on the bank and the fibre washed, squeezed of water and piled on clean ground. The fibre then should be spread on the roof of the house or a bamboo railing and left to dry for two to three days after which it can be disposed of as desired.

Marketing

The fibre should be graded into the four grades of top, middle, bottom and T.R. (Terrible Rejection) before disposal to get a fair price. At present most of the cultivators do not grade their produce but dispose of to *goladars*, or *arathdars* who grade them and make into bales of three and a half maunds or one and a half maunds and despatch to bigger markets for disposal. If the cultivators grade and bale the fibre themselves the excessive pronts made by the middlemen will come their way.

The distinguishing factors of the four grades mentioned above of the two species of *capsularis* and *olitorius* are given in Table I.

After grading lots of about five seers each should be taken and folded to give a compact bundle called *muttas* or *morahs*.

Yield

Yield depends on the fertility of the soil, the season, the variety sown, care of the crop, spacing between the plants, stage of harvest, time of sowing and incidence of diseases and pests. The yield of green stems is about 250 maunds and that of fibre between 10 to 20 maunds per acre (*capsularis* 10 to 15 md., *olitorius* 15 to 20 md.).

TABLE I

Characteristics of different grades of fibre

	Capsularis	*Olitorius*
Top	Sound fibre*, good colour, cuttings† not to exceed 25 per cent	Sound fibre*, good colour, cuttings† not to exceed 15 per cent
Middle	Sound fibre, average medium colour, cuttings not to exceed 35 per cent	Sound fibre, average colour, cuttings not to exceed 25 per cent
Bottom	Straight, morahad fibre, warranted to contain more than 70 per cent of the waste	Same as for *capsularis*
T. R.	Tangled as ravelled jute of whatever description	Same as for *capsularis*

* Strong fibre not weakened by over-retting, or by storage in a damp condition.

† Cutting means barky portions at the root end (even at the crop end) which have to be cut off for spinning a Hessian yarn.

Seed production

Low lands generally are not very suitable for this purpose. Unless a commercial production of jute seeds are contemplated it is better to leave small part of the crop for seed production for home consumption. If only seed production is desired it should be sown on upland. In the case of *olitorius*, when the plants become 2 to 3 feet in height, some cultivators prefer to decapitate with a bamboo or other stick, sharpened at both ends, to encourage shooting which will give better yield of seeds. Yield varies from 2½ to 4 md. per acre. *Olitorius* variety produces less seeds than *capsularis*. Fibre can also be extracted from these plants but they are much coarser and inferior. The fibre extracted from these plants can be used locally for rope-making, etc. The woody portion can be used for fuel, fencing or paper-making in cottage industry.

Cost of production

The ignorant cultivator is more concerned with the return he gets from growing a particular crop rather than any other point, national or sentimental. Table II clearly illustrates the net profit made by growing jute or other crops which are grown during the jute season. Jute gives the best return per acre. Therefore by growing more jute one can make more profit and at the same time do service to the country.

TABLE II

Cost of production per acre of jute for fibre, Aus *paddy, transplanted paddy and maize*

	Jute												Maize			*Aus* paddy			Transplanted paddy		
	Cultivators' conditions						Farm conditions														
	Capsularis			*Olitorius*			*Capsularis*			*Olitorius*											
	Rs.	as.	p.	Rs.	as.	p.	Rs.	as.	p.	Rs.	as.	p.	Rs.	as.	p.	Rs.	as.	p.	Rs.	as.	p.
1. Cost of production	87	2	0	95	2	0	104	4	0	112	4	0	64	10	0	49	14	0	49	12	0
2. Total yield	9 md. fibre			11 md. fibre			12 md. fibre			15 md. fibre			10 md. grain 20 md. cobs 40 md. stalk			8 md. grain 15 md. straw			10 md. grain 25 md. straw		
3. Receipt from the sale of produce	207	0	0	264	0	0	271	0	0	375	0	0	150	0	0	87	0	0	125	0	0
4. Net profit	119	14	0	168	14	0	171	12	0	262	12	0	85	6	0	37	2	0	75	4	0
5. Cost of production per md.	9	10	10	8	10	4	8	12	0	7	7	8	6	7	5	6	3		4	15	7

FOOT-ROT OF RICE IN MADRAS*

THE foot rot disease of rice caused by *Fusarium moniliforme* var. *majus* is one of the important diseases of the rice crop in South India. The disease is closely allied to the famous *Bakanae* disease of Japan and the *man* rice disease of British Guiana. The disease was first recorded in 1930, in the Madras Province at Maruteru in West Godavari District. It has since been recorded to occur in Coimbatore, Chingleput, Madura and Malabar Districts of the province. Though discontinuously distributed at present, it is a potential danger to rice production in India.

Nature and symptoms of the disease

The disease affects the crop in all stages but is mostly destructive in the seedling stage. When infected seed is sown a percentage of seed fails to sprout; when sprouted, fails to emerge from the soil. After emergence, seedlings may wither and die. But by far the most characteristic symptom of the disease exhibited by many varieties of rice is the appearance in the nursery of seedlings which are markedly taller, paler and more slender than the healthy seedlings. Many of these seedlings which exhibit the over-growth phenomenon ultimately die. Another characteristic symptom met with in infected plants is the abnormal development of adventitious roots from the first, second and often the third node above the ground level. The root system of affected plants further exhibit abnormal branching of the whorl of roots at the collar, giving the root system, a woolly appearance. When seedlings from infected bed are transplanted, a large number of them fail to establish with the result that large gaps are left in the field.

In the transplanted crop the disease may be recognized by the presence of tall lanky tillers, which reach the boot stage earlier than the rest of the crop, but bearing pale green flags which shoot up conspicuously above the general level of the crop.

Loss due to the disease

It has been mentioned that the disease is most destructive in the nursery stage. When heavily-infected seed is sown the entire nursery may be decimated with the result that there is dearth of seedlings for transplanting and a consequent reduction in the area planted to rice during the season. In the Godavari Delta, the disease is prevalent year after year in the 'Dalva' season (January-April) and losses have been estimated to range from 10 to 30 per cent in the nursery and 10 to 15 per cent in the tranplanted crop. In certain parts of Coimbatore District (Gobichettipalayam) the disease is endemic, and causes losses ranging from 10 to 20 per cent.

Control of the disease

Investigations carried out at Coimbatore, have shown that there is a considerable range of varietal susceptibility to the disease, while certain varieties are highly resistant as for example, GEB. 24, PTB. 7 which do not exhibit more than one per cent infection, even though artificially infected with concentrated spore suspension of the fungus, others such as Garikasannavari, Co. 10, etc. totally succumb to the disease under the same conditions.

The growing of resistant varieties as a means of controlling the disease is, however, not a practicable proposition at present, for the reason that where the disease is prevalent, the existing varieties are specially suited to the tract and the season in which they are grown and but for their susceptibility to the disease they are extremely good yielders, and the substitution of other varieties, for the sake of disease resistance may not find favour with the ryots.

The results of the experiments carried out in Coimbatore, have shown that the chief means of dissemination of the disease is through infected seed, and treatment of seed with organo-mercury fungicidal dusts like Ceresan (Tillantin R) or Agrosan GN. is very effective in controlling the disease. Almost complete control of the disease is effected by treating the seed prior to sowing with one gram of the fungicide for a pound of seed. Small quantities of seed can be treated efficiently by shaking the seed with the required quantity of the fungicide in a tin or mud pot provided with a lid. Large-scale treatments require a seed dressing machine to ensure thorough mixing. A simple and efficient machine may be made out of a 4-gallon iron drum, and a few feet of ½ in. diameter iron piping, at a cheap cost. A diagram of a machine is given below (Fig. 1). The drum is half-filled with grain, and the requisite quantity of the fungicide is added and after closing the lid the drum is rotated about 50 times to ensure thorough mixing. Treated seed can be stored indefinitely without risk of loss of germinating capacity. As however, the organo-mercury compounds are poisonous, care should be taken that treated seed is not utilized for human or animal consumption.

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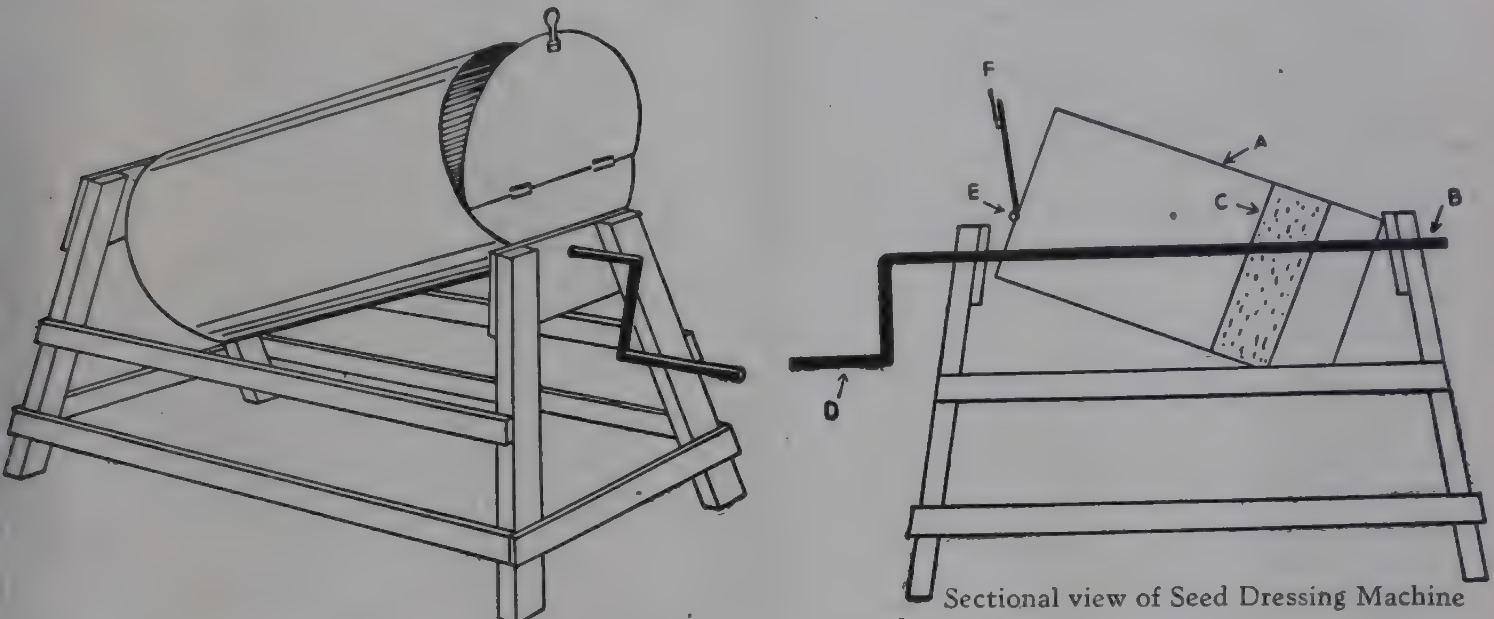
* Contributed by the Government of Madras.



Sectional view of Seed Dressing Machine

Seed Dressing Machine

A—Drum
B—Pipe welded to drum
C—Baffle board screwed to drum
D—Handle
E—Hinge
F—Hasp for fastening the shutter

Fig. 1. Seed Dressing Machine

In the Madras Province during the years 1946-47 and 1947-48, largescale demonstrations of the efficacy of seed treatment as a means of control of the disease were carried out in a selected village in Gobichettipalayam taluk, where the disease was causing considerable damage to the crop in previous years.

Arrangements for seed treatment were made well in advance of the sowing season, and the entire quantity of seed to be sown in the village (40,000 pounds) was treated with the fungicide. Examination of the crop raised from treated seed showed that the disease was completely absent, while, in a neighbouring village sown to untreated seed, there was nearly 20 per cent incidence. Arrangements are now in progress to have the entire tract sown to treated seed.

CERTAIN NEW INSECTICIDES AS PREVENTIVE AGAINST HIDE BEETLE*

THE existing practice to treat hides and skins with an arsenical solution or to add naphthaline to prevent attack by Hide beetle (*Dermestis vulpinus*) was not considered quite satisfactory. Trials were carried out to investigate the effectiveness of DDT, Gammexane, Sodium Silicofluoride. These insecticides were applied in the form of dust, solution in organic solvent and watery emulsion to treated skins from the country of origin (Uganda) which were subjected to attack by 285 larvae and 95 adults of Hide beetle. These skins were examined in England and then put to tanning trials, in which special attention was paid to the presence of insect damage and to the behaviour of the skins during the various tannery operations with reference to the possible effect of the insecticides on the process, or on the appearance and quality of the resultant leather. In the case of DDT, 50 grams in the form of powder, 16 gm. in organic solvent, and 19 gm. in watery emulsion per 100 sq. ft. were effective. All the applications of Gammexane were 100 per cent effective, including the smallest dose of 1·3 gm. per 100 sq. ft. of skin. Sodium Silicofluoride was effective at the rate of 126 gm. per 100 sq. ft. Thus all the three insecticides are capable of protecting skins against Hide beetle attack, when applied in suitable quantity and their use does not affect the handling or subsequent chrome tannage of the skins.

The report indicates that in future experiments, attention will be paid to the use of water emulsion and dispersions, since this method proved to be more efficient than use of insecticides in dust form and is less costly than the use of insecticides in an organic solvent. In the present trials with this method, no putrefaction or taint was observed of which there is latent possibility because of the re-wetting of hides and skins, required in this procedure. (H.K.L.)

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* Abstract of the Report on First Series of Trials to determine the value of certain new insecticides as preventive against Hide beetle (Imperial Institute Consultative Committee on Hides, Skins and Tanning Materials).

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Will you please state if any researches are being carried out in this country for the production of vegetable rennet?

A. As many people in this country object to the use of animal rennet used in the process for making cheese or other milk products, the Indian Council of Agricultural Research had taken up research on the production of vegetable rennet. Active enzyme having qualities similar to those of rennet is found in the berries of Withania Coagulans (*Panir*). The seeds, leaves and stems of the plant have no active enzymes. Most of the active enzymes can be extracted from the pulp with water. Attempts have been made to concentrate the enzymes by precipitating with alkalies, acids, sodium chloride, ammonium sulphate, magnesium sulphate, alcohol and acetone. A very active material was obtained by precipitation with acetone at room temperature. The activity of this material compared very favourably with that of the imported animal rennet. But the enzyme concentrate still contained some impurity as all of it did not go in solution and the insoluble matter that is left is inactive. It has been found possible to prepare soft cheese of a very good quality using vegetable rennet which is indistinguishable from that made with animal rennet. With cheddar cheese, however, some difficulty was encountered and slightly bitter taste persisted after the cheese was cured.

Further experiments which were being carried out to purify the enzyme had to be postponed due to lack of material, because the plant Withania Coagulans is found in the N.W.F.P. (now in Pakistan). (H.K.L.)

INDIAN DAIRY RESEARCH INSTITUTE, BANGALORE

H. LAXMINARAYANA

THE principal activities carried out at the Institute include (i) training of students for the Indian Diploma in Dairying, (ii) breeding, feeding and management of pedigreed herds of Red Sindhi, Gir and Murrah breeds and (iii) research work on problems connected with the dairy industry of the country. The research problems investigated during the quarter ending 31 May 1948 cover several important aspects of the industry.

Important investigations

In addition to better feeding and management of dairy animals, experiments are being conducted to increase the milk yield of animals by artificial means. Intravenous administration of nicotinic acid to Sindhi cows has not so far resulted in any appreciable increase in yield. The nutritive value of milk, butterfat, groundnut oil and *vanaspati* used as supplements to the usually poor South Indian vegetarian rice diet is being examined. Results of biological assay with rats have shown that the usual South Indian vegetarian diet suffers from multiple deficiencies and the addition of suitable amounts of milk helps in maintaining normal growth and reproduction. Other important investigations undertaken on the purely chemical side, which are still incomplete, include the chemical composition of milk of cows, buffaloes, goats and sheep; nature of enzyme systems and amino-acid make up of proteins in the milk of different species of animals; growth-promoting value of fatty acid fractions of cow and buffalo *ghee*; and effect of heat treatments on the nutritive value of milk.

Market milk

Bacteriological studies carried out on market milk in Bangalore reveal that milk produced and handled under hygienic conditions in summer shows an average bacterial count of 60,000 per ml. at the time of production, about 200,000 per ml. in the bulking can before despatch and up to 1,000,000 per ml. at the time of delivery to the consumers. In the case of village-produced milk, the average bacterial counts vary from 500,000 per ml. in the farmer's house to anything between one and ten millions per ml. at the time of delivery to the consumers in the city (a distance of 5 to 10 miles). The main factors responsible for the high counts have been found to be the unsatisfactory cleanliness of utensils used for handling milk and the inevitable effects of temperature and time of transport. In the case of milk passing through intermediate agencies such as private dairies, the quality was found to be much worse. Coliform bacteria, lactic streptococci, aerobic spore-formers, micrococci and corynebacteria were the predominant types of bacteria encountered in milk in the order mentioned. Among the aerobic spore-forming bacteria, which are generally associated with the sweet curdling of milk and spoilage of boiled milk, B. subtilis, derived from concentrate feeds, grass, hay, coat of the cow and dung, was most frequently present, B. cereus and certain thermophilic types ranking next. The first two very actively curdled and peptonized milk. The role of certain preservatives and bactericidal substances in destroying or inhibiting bacteria and improving the keeping quality of raw and heated milks is being investigated. Very encouraging results have been obtained with the use of hydrogen-peroxide.

Studies on dahi

In the course of biochemical studies on *dahi* produced in different parts of the country,

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some of the best samples have been obtained from Calcutta, Darbhanga and Muzaffarpur areas. Several strains of lactic streptococci and lactobacilli, combining fast curdling ability with good aroma production, have been isolated and studied with a view to utilizing them as starters. Experiments have also been conducted to determine the conditions necessary for the production of good quality *dahi*. Earthenware pots were found to be superior to metallic vessels in obtaining good flavour, provided they were scrupulously clean. The latter often gave off-flavours. Better flavour was also obtained by using shallow vessels than deep ones and in the latter case, the flavour could be improved by aeration and vigorous shaking for 10 to 15 minutes.

Desi *and creamery butter*

Interesting observations have been made regarding the microflora occurring in market samples of creamery and *desi* butters. Yeasts and moulds were found to predominate in *desi* butter, while bacteria of various types were preponderant in creamery butter. This difference is attributed to the acid environment in *desi* butter (which is prepared from soured milk) which inhibits bacterial growth with the exception of a few selected types. Accordingly fungi generally bring about rancidity and other defects in *desi* butter while a number of lipolytic and proteolytic bacteria take part in the deterioration of creamery butter.

Butter prepared by *desi* method (particularly from buffalo milk) was found to develop acidity rapidly. Unwashed butter kept dipping in water showed the least development of acidity followed by unwashed butter kept in 2 per cent saline. Experiments carried out on the clarification of *desi* butter into *ghee* have indicated that when the melted butter was allowed to sediment for 60 minutes at 85°C., a clear cut separation of fat and buttermilk serum was brought about. The *ghee* prepared from fresh *desi* butter by sedimentation compared well with that obtained by direct heating of butter in respect of yield, acidity and vitamin A content. When the samples were aged, direct heating led to a reduction of vitamin A. On storage, samples made by direct heating developed tallowy flavour in 30 days while the other set of samples retained their marketable quality for over 30 days and they were consumable even after 60 days. The nature of grain formation of *ghee* was not found to depend on method of manufacture or initial acidity of butter. Developed acidity due to lipolysis of fat rendered the product pasty. Sudden cooling to 25°C. imparted a pasty texture, but gradual cooling at 28°C. for 6 hours followed by lowering the temperature of cooling to 25°C. gave satisfactory results.

Khoa

Production of *khoa* from skim milk and incorporation into it of suitable vegetable fat so as to give it a normal body and texture has been successfully worked out. Addition of 3 per cent fat and reconstitution with 25 per cent water gave a product of acceptable texture. Samples of skim milk *khoa* wrapped in butter paper and stored at atmospheric temperature or 100° F. did not show any deterioration in quality for a period of eight weeks.

Transport of milk

A technique for the collection-cum-processing and transport of milk over long distances in a specially constructed motor van has been developed and is being put to field trials. A 'theft-proof' container to prevent adulteration of milk during delivery rounds has also been designed.

MADRAS

T. S. FRANCIS

WITH the realization that the available supplies of artificial manures such as chemical fertilizers and oilseed cakes are hardly sufficient to adequately manure a tenth of the total paddy lands of this province, the Madras Agricultural Department launched a campaign to grow green manure crops in all paddy lands where water supplies were available and to raise green-leaf-yielding quick-growing shrubs and trees in all available vacant lands and on field bunds and channel edges for manuring paddy lands. This campaign is being conducted vigorously through the coordinated efforts of the Agricultural, Revenue, Forests and Irrigation Departments.

'Grow more food' campaign

The Madras Agricultural Department has been making all-out efforts during the past few months to procure all the available quantities of green manure seeds in the province for distribution to the ryots of the delta lands chiefly for growing green manure crops for manuring paddy land and increasing production. The Cauvery-Mettur Project area in the Tanjore district has been selected for intensive work in connection with this campaign. It is proposed to distribute 10,000 bags (160 lb. each) of green manure seeds of sunn hemp and *pillipesara* (*Phaseolus trilobus*) in this area of over 1 lakh acres. In order to encourage poor cultivators to grow green manures, the seeds are to be sold at half price to farmers owning lands three acres and less in extent. It is estimated that the cost of raising green manure for manuring one acre of paddy land would be only Rs. 6. The increase in yield from such manuring would be about 360 lb. of grain. The cost works out to Rs. 22 per acre when other manures such as oilseed cakes are used.

Fruit Show

The most important agricultural event in South India during the past few months was the provincial Fruit Show organized by the Madras Agricultural Department synchronizing with the All-India Horticultural Conference held at Madras from 21 to 23 May 1948.

The Fruit Show was declared open by the Hon'ble Sri Jairamdas Daulatram, Minister for Food and Agriculture, Government of India, who congratulated the Department in setting a good example by organizing this Fruit Show, and hoped that the ideal before the province would be plenty of fruits for all and at all times.

Representative collections of every fruit grown in the Madras Province were exhibited. There were 70 different varieties of mangoes alone, notable among them being some hybrid varieties evolved at the Fruit Research Station of the Madras Agricultural Department. Among the hill fruits were such rare fruits as mangosteens, tree tomatoes, feijoa, Surinamcherry, all of which are now the monopoly of South India after the partition of India. The Alphonso mango grown in Madras was judged to be the best mango exhibited in the Fruit Show, which included exhibits from Baroda, Hyderabad, Coorg, Travancore and other provinces, by a special committee of judges drawn from all parts of the Indian Dominion.

The highlight of the function was a miniature orchard in the centre of the show grounds, containing demonstration plots illustrating the important nursery and orchard practices with self-explanatory placards to guide interested observers.

T. S. FRANCIS is Gazetted Assistant to the Headquarters Deputy Director of Agriculture, Madras.

COCHIN

N. SANKARA MENON

THE north-east monsoon of 1947 was a complete failure and all crops, especially the second crop of paddy locally called 'Mundakan', were affected to a great extent by drought in many parts of the State. Steps were taken immediately to supply water to the crop by putting up pumps near rivers and other sources of water and bunds were put up across channels and rivers to divert water to lands lying on higher levels. All the available engines and pumps were taken possession of by the State Government and this work was pushed on with such vigour that thousands of acres of paddy which would otherwise have completely dried up were irrigated in time and yielded a fair crop. The whole expenditure was met by the Government and cultivators were not charged anything. The pumping sets available in the State were not sufficient to provide irrigation water over the whole affected area and the crop in some places was a complete failure.

Minor irrigation works

A rapid investigation conducted by the Government showed that the construction of bunds across channels and small rivers, silt clearing of existing tanks and digging new ones in certain localities would provide water for paddy even when the monsoon was a partial failure and these works in many cases would enable the cultivators to take a second crop of paddy in single crop lands. About four lakhs of rupees have already been spent on such works and seventytwo items have been completed. The outturn of paddy in the State is expected to show a considerable increase in the next year.

Major irrigation works

Though minor irrigation works, each one benefiting 200 acres or less, have their own importance in ensuring the successful cultivation of crops, yet the necessity for a major irrigation work, capable of providing water to a larger area as a safeguard against the partial failure of monsoons and also to take additional crops, has been keenly felt and the Cochin Government, after careful investigation, have proceeded with the construction of the Peechi dam. The dam is proposed to be constructed across the Manali river at Peechi and it will store water over an area of about four square miles. It is estimated that 8,000 acres of dry land can be put under paddy and it is possible to take a second crop of paddy on 6,000 acres of existing single crop paddy lands. The water from the storage can be used to irrigate 6,000 acres of existing double crop paddy lands also if the monsoon fails. The 'Kole' or summer crop of paddy which cover an area of about 15,000 acres is often subjected to drought and water can be provided to these lands also in times of necessity. The estimated expenditure is one and a half crores of rupees. There will be appreciable increase in the production of paddy when the work is completed.

'Grow more food' campaign

The necessity for increasing food production still exists and the Government are taking several steps to produce more food by giving subsidy on the selling price of manures. A subsidy of 25 per cent on the selling price of manures intended for paddy had already been sanctioned by the Government to induce cultivators to apply manure and produce more paddy. This subsidy is now increased to 50 per cent so that manures can be used on a larger scale and production can be considerably increased. Cultivators are taking advantage of this generous gesture made by the Government and the demand had increased so much that the Agricultural Department finds it very difficult to meet the entire requirements with the available stocks.

Tapioca is an important food crop in the State and the consumption of cereals can be reduced if it is available in sufficient quantities at a cheap rate. The cultivation of this crop has therefore to be encouraged. A sum of

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Rs. 50,000 was advanced as loan for the cultivation of this crop and an intensive campaign was conducted to persuade cultivators to raise this crop on a large scale. Hundreds of acres have been put under tapioca as a result of these efforts and the produce will be of great help when there is scarcity for rice.

Seed and cash loans to the extent of about Rs. 5,000 were given for re-cultivating paddy lands where the crop was destroyed by floods and these loans were to be repaid without interest after the harvest of the crop.

Compost

The value of compost as manure has been proved beyond all doubt and the necessity for converting all available organic refuse into valuable manure has been fully realized throughout India. Demonstration on the preparation of compost is taken up in ten *panchayats* in the State so that cultivators can study the process in detail and adopt it in their farms. A sum of Rs. 1,200 has been set apart for this purpose. These demonstrations and the propaganda conducted by the Agricultural Department will induce several cultivators to prepare compost by utilizing all organic waste. Compost is now prepared in a few municipalities and *panchayat* areas and the remaining *municipalities* and *panchayats* have been directed by the Government to investigate the possibility of preparing this manure. The Ernakulam Municipality is now selling compost at very reduced prices to make it popular among cultivators.

Tractors

Tractors were not used in the State till now for tillage operations. The cost of ploughing can be reduced very much and the work can be done with greater speed if tractors are used and it may be possible to cultivate a large area with food crops if the tillage operations are done cheaply and quickly in time. The Agricultural Department procured two tractors and demonstrations on ploughing were conducted. The tractors are now given on hire to cultivators and the hire charge is only Rs. 10 per acre. The demand for these tractors is increasing since the cost of ploughing is less than what the cultivator has to spend when bullocks are used and the work is done more thoroughly.

CROP ESTIMATES

ACCORDING to the Directorate of Economics and Statistics, Ministry of Agriculture, the following are the estimates of acreage and yield in respect of wheat in the Indian Union for 1947-48. These correspond to the final wheat forecast which could not be released in time, owing to delays in the receipt of information from several reporting areas.

The area is 20,207,000 acres and the yield 5,346,000 tons as compared to 24,350,000 acres and a yield of 4,745,000 tons in 1946-47. This represents a decrease of 17 per cent in acreage but an increase of 12·7 per cent in yield.

These estimates do not include figures for a few small States in the Bombay States Group for which forecast returns have not been received. The wheat acreage in these States is of the order of 90,000 acres.—*Food Bulletin*, September, 20, 1948.

WORK OF THE FOOD AND AGRICULTURE ORGANIZATION

THE Food and Agriculture Organization was established in 1945 following on the Hot Springs Conference on world food problems two years previously. Its main objectives were the establishment of the dietary needs of the peoples of the world and the correlation of the production of food to these nutritional requirements. To achieve these ends it was necessary to promote in all possible ways the scientific development of agricultural production and to assist in organizing the world's marketing and distributing machinery for handling agricultural produce.

FAO's work in the dissemination of technical knowledge has been reasonably straightforward, and during its existence the organization has published a number of papers on technical questions, investigated such problems as the infestation of stored foodstuffs, and sent missions to several agriculturally backward or war-devastated countries to advise them on agricultural development and reconstruction.

In the sphere of world economics and the marketing and distribution of produce FAO has had a much more difficult trail to blaze, the task not being made any easier by the state of political uncertainty in practically all of Europe and the precarious economic position of the leading European countries.

World Food Proposals

Appreciation of this difficult situation inspired the then Director-General, Sir John Boyd Orr, to issue in 1946 his World Food Board Proposals. These were considered at the Copenhagen Conference in September, 1946, and a special commission known as the Preparatory Commission on World Food Proposals was set up to investigate the whole question. This commission sat for several months and issued its report in January, 1947.

It recommended the establishment, not of a World Food Board, but of a World Food Council of 18 members generally to administer the production and distribution of world supplies of food and raw materials. The commission was convinced of the desirability of preventing, as far as possible, that disturbing instability of prices which characterized the period between the wars. To achieve this it was considered that the most satisfactory method would be by inter-governmental commodity arrangements and agreements. It was also proposed that these agreements provide for the creation of a famine reserve of basic foods held nationally for use internationally, and the establishment of limited price stabilization reserves or buffer stocks for commodities subject to seasonal and cyclical fluctuations. Among other recommendations was one for the sale of agricultural surpluses at special prices to countries in need but lacking the foreign exchange to buy their full requirements. At the 1947 FAO Conference at Geneva, the Preparatory Commission's recommendations formed the basis of much of the discussion.

International Trade Organization

During the first seven months of 1947 there had taken place, first at New York and later at Geneva, meetings of the preparatory committee established by the United Nations to consider the establishment of an International Trade Organization with general objectives wider in scope but similar in many respects to those of FAO. The report of this committee advocated commodity studies and commodity agreements under the aegis of specially constituted commodity councils.

It was probably with this development in mind that the 1947 Conference recommended the establishment, not of a World Food Council, but of a Council of FAO, composed of 18 member nations elected by ballot, with objectives similar to those envisaged by the Preparatory Commission. As New Zealand has had two years' representation on this executive committee, Australia has now been elected to act on the new Council. It is expected that this position will alternate between Australia and New Zealand on a three year term of office.

This Council was elected at the Conference in September and held its first meeting from November 4 to 11. Its immediate tasks are concerned with short-range problems of food shortages, and one of its most important acts was the absorption of the functions of the International Emergency Food Council, which now becomes a committee of the Council of FAO. Other recommendations ranged from short-term problems of foreign exchange, fertilizers, farm machinery, and other requisities of production to long-term problems of agricultural-industrial expansion. A committee was established known as the Policy Committee on Production and Distribution, which, working with the staff of FAO, will secure all possible information on the individual production plans of member nations. In general commodity policy the council's activities are taking the form of recommending the maximum utilization of available supplies, particularly milk products and cereals.

Future of FAO

At present any prophecy about the future of FAO is difficult and in any case unwise. It is essential for the future stability of the world that the United Nations Organization and its agencies should function among the democracies, and FAO can play its part. It is of importance that recently 36 nations signed a five-year international wheat agreement containing some startling departures from orthodox procedure, but in line with the principles advocated by FAO.

If FAO in collaboration with the International Trade Organization can establish further inter-governmental commodity agreements of a similar type to the wheat agreement, it will undoubtedly have an important future in the realms of international economics. It is hoped that the organization may eventually assume a role in relation to food and agriculture synonymous with that held by the International Labour Office in the field of labour and employment.—Reproduced from *New Zealand Journal of Agriculture*, April 1948.

Home Gleanings

FARM FORESTRY IN INDIA*

By A. P. F. HAMILTON

IN their pronunciation of forest policy in 1894, the Government of India underlined two important principles; first, the necessity for securing sufficient forest for the general well-being of the country and second, that the preservation of the climatic and physical conditions of the country came before anything else. During the past half-century various influences have caused an extension of agriculture over vast tracts of land with but little considerations for the foregoing principles. The development of agriculture has been on extensive rather than intensive lines and without due regard to the primary needs of the industry; as a result an ill-balanced rural economy, with its attendant evils of erosion, reduced soil moisture content, shortage of fuel, timber and grazing, has developed over these areas.

The distribution and extent of India's forest reserves is far from satisfactory from the point of view of the 1894 policy; to a limited extent only can the State forests meet the requirements of the agricultural community and afford protection against unfavourable climatic influences, both of which are essential to the establishment of permanent and prosperous agriculture. In a country like India where a capricious rainfall and the prevalence of much marginal land only too often reduce agriculture to the level of precarious subsistence farming, these essentials are of increasing importance. Agriculture in India is in dire need of the assistance of forestry; the extension of State forests may improve matters locally, but the real solution is to bring forestry on the farm; in other words, those same two principles of forest policy must be given a far wider application and must be extended to the whole countryside. And in the fullness of time the farmer himself must be the agent for giving effect to this policy.

A. P. F. HAMILTON, C.I.E., O.B.E., M.C., I.F.S., was Inspector-General of Forests, Government of India.

The task

The term 'farm forestry' conjures up visions of well-timbered, self-sufficient agricultural lands with every farmer his own forester; and though this may be a possible, however distant, goal in some parts of the country, there are practical difficulties which will compel the use of expediencies not seen in normal forest practice.

In short the general objects of farm forestry in India are:

(a) to achieve the maximum degree of self-sufficiency as possible on the farm;

(b) to utilize the land to the best advantage;

(c) to increase the fertility of agricultural lands by preventing erosion and increasing water storage in the soil, by mitigating the desiccating effect of hot winds, by providing firewood in place of the cow-dung at present almost universally used as fuel;

(d) to improve the condition of cattle by introducing pasture management and stall-feeding and by providing leaf fodder to supplement the chronic fodder shortage;

(e) to supplement, where possible, the farmer's income.

Farm forestry has to be adapted to meet a great variety of conditions. There are the great estates in the north-west, arid, tree-less and wind-swept where the tradition of cattle-herding is strong and the landlords often apathetic; the 'desert fringe' of Sind and Rajputana with its menace of shifting sands; the intensively cultivated tract of the Indo-Gangetic plain where holdings are often small and fragmentary; the ravine lands skirting many rivers and ranges; the vast tract of the Deccan uplands, constantly under the shadow of famine; and finally the heavily cultivated rice lands of the south.

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* Written for the Fifth British Empire Forestry Conference, United Kingdom, 1947.

Though the remedies may often be obvious, their application is the real problem. It is difficult to convince an uneducated peasantry, often lacking in imagination, that by changing his method he can escape from the conditions which he and his forefathers have come to accept as inevitable.

Systems of land tenure and tenancy vary greatly, requiring different approaches to the same problem ; until there is a clear understanding on both sides of the meaning and intentions of Government policy, attempts to establish farm forestry may sharpen the conflict between the interests of landlord and tenant. Indiscriminate and excessive grazing and browsing, due partly to religious prejudice and partly to a vicious circle set up by misuse of the land itself, is one of the greatest difficulties, the final solution of which must rest with the people themselves.

Finally there is the question of finance ; the country is poor, and the resources of the State are not unlimited. The establishment of a balanced farm economy will require the sinking of considerable capital in the land ; both the State and the farmer will contribute towards this but outlay in terms of money and effort must, to some extent, be related to the capacity of the land to respond to a given technique and, in the long run, to repay the capital and effort. But any tendency to take too parochial a view of the financial aspect would be a mistake for, as has already been explained, farm forestry is an extension of an intrinsically sound all-India forest policy and is itself a nation-building movement.

Government's role

Schemes for the development of farm forestry must be closely integrated with general planning for the improvement of the countryside and this means that the activities of a number of departments, Agriculture, Forestry, Animal Husbandry, Revenue and Cooperative, must be closely coordinated. Rural development is not new in India, but the departments have worked apart, coordination has been wanting, and experience has shown that the ordinary departmental machinery, even though it may be coordinated at ministerial level, is unable adequately to cope with plans which involve the multiple use of the land. A vast field has to be covered and the only practical policy seems to be the formation of a single organization which will ensure both continuity of policy and the coordination of experience and effort. Such an organization, either a separate Department, or a Board suitably represented at the corresponding administrative levels, would, to begin with, be manned with experts drawn from the departments, but might later recruit and train its own staff. This policy is strongly advocated by Provincial Forest Departments and it is hoped that local Governments will accept it. It is hardly necessary to emphasize the need for securing the cooperation of the public by encouraging the formation of local non-official bodies.

In the meantime, however, considerable progress has been made and everywhere the Forest Department has taken the lead. Pending the formation of a composite organization, the tendency is to expand the department on a territorial rather than a functional basis, though there is some disagreement on this point. The ultimate object is to have in every district, a forest officer who will be responsible for all land development activities on the forest side, including pasture management, soil conservation, shelter-belts, firewood reserves, etc. The subsequent formation of a separate department would not be seriously prejudiced by departmental expansion on these lines.

Farm forestry and all that it implies is daily bringing the Forest Department into closer contact with the rural population, but it is recognized that there must be a closer link with the village and with the farmer than the ordinary departmental staff, with its highly technical training, can provide. Something of the nature of an ‘ extension service ’ is required, and one province has already set up a school which provides free training in the elements of forestry and soil conservation to men drawn from the cultivating classes.

A corollary to this section is that the officers of each department should know something about the work of the others and instruction to this end should begin at the training institutions.

Farm forestry in practice

There are numerous examples to show that in the better developed parts of the country the farmer at one time appreciated the necessity for conserving his land and supplying his own requirements. His efforts to do so have often failed owing to lack of technical knowledge, and often the good work of a prudent father has been undone by an improvident son. The value of closure to grazing and the training of torrents is not unknown, particularly in the north-west. Shelter-belts have been planted but usually for the protection of orchards; in arid, wind-blown tracts the relics of hedges or low wind-breaks are a not uncommon sight and the growing of trees on the boundaries of fields or round wells is a feature of some parts of the country; the value of the lopping of certain trees for fodder and green manure is understood, though it may be practised in a destructive and wasteful manner. Of recent years the growing of firewood plantations of *Casuarina equisetifolia* in the eastern coastal belt has become popular and very high prices have been obtained by the owners.

In the Punjab soil conservation measures undertaken by the Government have demonstrated the value of farm forestry and the demand for assistance by individual farmers and village communities for the formation of plantations on their lands is increasing. Thousands of acres of *Dalbergia sissoo*, one of the most valuable trees in India, have thus been established on private lands and many are already managed under working plans or schemes with the active cooperation of the owners.

Local conditions necessitate wide variations in the methods of approaching problems, in technique and choice of species and this latter will require the closest attention in view of the widely differing objects of management. In general farm forestry is being planned on the following lines:

(i) The proper management of privately-owned forest under working plans will be enforced by legislation.

(ii) The owners of large agricultural estates will be encouraged to retain a small area, say, 5 per cent, of the land under tree crops, and to afforest waste land; the Government may be vested with residual powers of compulsion.

(iii) Where there is a well-organized village community, the common land, or neighbouring Crown waste, if there is any, will be managed as village forest by cooperative societies or village committees under working schemes.

(iv) Farm forestry will be closely integrated with major or minor soil conservation and land development plans; and the opportunity for laying the foundations of a well-balanced economy *ab initio* will be seized wherever large-scale colonization schemes are undertaken.

(v) In the intensively cultivated tracts with small, often fragmentary, holdings, farm forestry in the real sense is not possible. These areas are, however, critically short of forest produce. The peasants will be encouraged to grow deep-rooted and valuable trees such as *Acacia arabica* on field boundaries, round wells, etc. and on small areas of uncultivable land. Starting with two or three trees per acre, the cultivator, when he realizes the advantages, will himself work out the optimum number of trees that he can grow round his fields. The consolidation of holdings has greatly assisted farm forestry.

(vi) Hot drying winds, particularly those which blow at the end of the winter and monsoon rains when the grain is beginning to swell, seriously reduce crop yields. Shelter-belts on the American and Russian scale may be impracticable in India, but the Government must be responsible for what primary system is possible, and this will mainly take the shape of canal and roadside avenues and the margins of rivers. For the rest, the measures described above will do much to provide a system of interrupted shelter-belts. Research, under-taken jointly by the Agriculture and Forest Departments, to establish the most suitable species and technique for shelter-belts and wind-breaks is important.

(vii) Grazing and fodder requirements are given prominence in land planning.

(viii) Farm forestry will be made to pay where possible. The production of many valuable minor forest products, such as tanstuffs, fibres, lac, gums, grasses, can be developed, and local industries will be encouraged.

(ix) Financial assistance is often necessary; policy varies, but loans on easy terms are made to larger farmers and landlords; subsidies are given to impecunious cultivators on certain conditions.

(x) An organization for publicity and education is essential.

(xi) The basis of land planning must be a survey of a region, conveniently a civil district, which will provide a blue print of economic development. A survey might indicate the necessity for establishing State firewood reserves to prevent the denudation of the countryside by the demands of some local consuming centre or industry.

Legislation

Legislation is necessary for two purposes, firstly, as in the case of State forests, to provide protection for private and community forests, particularly in localities where respect for property leaves something to be desired. There is such provision in the Indian Forest Act, and it is being used.

Secondly, legislation of a compulsory nature is necessary to give effect to the principle of the greatest good of the greatest number; the progress of plans must not be obstructed by a recalcitrant minority. Legislation in this sense has already been enacted in India in the interests of soil conservation and experience has shown that if it is used wisely and is backed by a sound policy, resentment which may have been shown to begin with soon dies down, and is followed by willing cooperation.

The degree of State interference will naturally vary, and it can be assumed that for a long time the management of farm forests will have to be closely supervised by the Government. But it must always be the primary duty of those entrusted with the furtherance of the movement to train the landlord or farmer to manage his own land and to inculcate a spirit of self-help.

APPEAL FOR COOPERATION FROM THE PUBLIC

Enquiry into the Economic Consequences of the Partition

AN intensive enquiry into the economic consequences of the Partition has been undertaken by the University School of Economics and Sociology, Bombay. In order that this work can be as comprehensive as possible it is proposed to approach those individuals, who are in a position to give authoritative information on any aspect of the economic issues arising out of the Partition. Those who are in a position to help are requested to get into touch with the Director of the School. Communications should be addressed to Professor C. N. Vakil, Director of the School of Economics and Sociology, University of Bombay, Bombay 1.

Book Reviews

CYTOGENETICS AND PLANT BREEDING

By S. N. Chandrasekharan and S. V. Parthasarathy (Published by P. Varadachary & Co., 8, Linghichetty Street, Madras, 1948, illustrated, pp. xvi+589, Rs. 12-8).

WE are so long accustomed to foreign text-books, specially in agricultural sciences, that the appearance of a good text-book written by our own workers, dealing with indigenous crops and problems, should be considered an event of considerable importance in the history of the development of agricultural sciences in India. Plant-breeding work is being extensively done in this country and the publication of a full-fledged Indian text-book on this subject was long overdue. The appearance of the present publication is likely to have a considerable influence on the future generations of plant-breeders in India.

The book contains 25 chapters, dealing with various phases of cytogenetics, genetics, plant-breeding and applied statistics, 161 illustrations and diagrams, and seven appendices, which include a glossary and an extensive bibliography. The book is furnished with a combined author-subject index. The authors together have had considerable experience in the teaching of botany and research in plant breeding and are evidently aware of the educational needs of young agricultural undergraduates. They have succeeded in meeting these needs by providing ample information and examples from the results of published investigations by Indian workers and illustrating the text extensively.

The first fourteen chapters deal with various phases of cytogenetics and genetics such as reproduction, segregation and independent assortment, gene interaction, cell division, chromosome theory, linkage, variation, mutation, polyploidy, structural changes in the chromosome, sterility and evolution and natural selection and history of genetics. The chapters on cytogenetical aspects are specially good. Considerable attempt has been made to impress the student that the genetical consequences are a function of chromosomal behaviour and implications of various genetical phenomena in plant breeding have been emphasized.

The next eight chapters (XV to XXII) are devoted to various aspects of plant breeding and cover such topics as pureline and clonal selection, selection by hybridization, breeding for disease and insect resistance, crop deterioration and phasic development of plants. The inclusion of the last subject is an usual feature of a plant breeding text-book. Unfortunately, the authors have enumerated certain controversial topics such as Lysenko's views on genetics, which are likely to confuse the student. The other chapters consist of extensive and valuable plant breeding information about Indian crops and suggestions for their improvement.

The last three chapters deal with statistical methods usually employed in plant breeding work. Necessary reference tables have been given in the first three appendices. The fourth appendix lists standardized genes symbols for rice, *sorghum* and cotton as recommended by the special sub-committees of the Indian Council of Agricultural Research. An extensive list of chromosome numbers is given in appendix V. The remaining two appendices consist of a glossary and an extensive reference list. The book is thus useful to a certain extent to research workers also.

The first edition of a book usually suffers from certain 'inherent' drawbacks and the present text has not been able to escape these. While it is not possible to indicate here all or most of such defects, which the reviewer has noted, mention may be made of a few outstanding ones. One feels that the authors have attempted to bring together too much detailed information in a text-book for beginners and have not been sufficiently critical regarding the inclusion of various matters, especially when dealing with genetical and plant breeding phases. Another impression that the book creates is that it confines itself too much to Coimbatore work, and does not do sufficient justice to certain provinces where considerable amount of genetical and plant breeding work has been done. In order to be adoptable all over India, a text-book should try to familiarize the student with the all-India important crops and problems.

Speaking more specifically, in certain cases proper examples have not been chosen. For instance on page 109, the authors point out that coupling phase is more efficient than repulsion; yet as an example of a repulsion phase linkage data from *jowar* is used to illustrate linkage phenomena. Similarly, to illustrate the back-cross segregation the same example from *jowar* has been utilized. This may lead the student to feel that it is easy to effect back-crosses extensively in a crop like *jowar*. On page 369 examples of hybrid vigour in crops like rice, cotton and *jowar* are given. Such examples are likely to mislead the inexperienced student to believe that it is commercially possible to obtain hybrid seed in such crops. Under 'achievements by pure-line selection' improved strains of *bajra* (a very highly cross-fertilized plant) have been enumerated (page 324). In the statistical portion no indication is given about the missing plot technique, the knowledge of which is essential in practical work.

In figure 32 the 'resting stage' of the cell is shown as a complete blank. Reference to Fig. 37 on page 83 appears on page 95. The Fig. 74 has been evidently printed up-side-down and does not conform to the legend below.

Textual errors are not infrequent throughout the book and are conspicuously evident in the bibliography which requires very careful revision as it suffers from other serious defects also.

In spite of such shortcomings, which can be easily eliminated in the second edition, the book is worth recommending as a text for the teaching of genetics and plant breeding at the various Agricultural Colleges in the country. In fact active plant breeders would be greatly benefited if it is available to them for ready reference. The get-up of the book and the printing is good except for certain black and white and the colour illustrations. Considering the post-war rise in cost the book is reasonably priced. (B.S.K.)

WOOD CORROSION AND HOT CHEMICALS

THE effect of hot chemicals on Cypress both in the natural state and after various protective treatments is described in the Indian Forest leaflet No. 101, which has just been published. The treatments studied showed varying degrees of protection, phenol-formaldehyde generally being the best. Cypress was found to be resistant to hot sulphuric acid up to 10 per cent even when unprotected.

DEVELOPMENT OF FRUIT PRODUCTS INDUSTRY

AT the two-day session of the Fruit Products Manufacturers' Conference which concluded in New Delhi on 3 August 1948, questions relating to fruit products industry were discussed and a number of recommendations made.

A resolution was adopted that as the Central Government is responsible for the standardization, protection, export, transport and other aspects of the Fruit Preservation Industry and as it is a basic industry, it is essential that the administration of the Fruit Products Order should rest with the Central Government both in the matter of policy and that of execution.

Representatives of the industry were asked to draw up a memorandum regarding the assistance they would like the State to render for the growth of the industry, for consideration by the Tariff Board.

Certain amendments to the Fruit Products Order were suggested. It was decided that a sub-committee should go into the question and make recommendations in the light of the discussions held.

At its session on 2 August 1948 a draft scheme for banderoles intended to remove the difficulties in the matter of charging licence fees was considered. A Sub-Committee was appointed to draw up a detailed scheme of banderoles before circulating it to the Fruit Products Industry.

Addressing the Conference earlier, Dr G. S. Cheema, Fruit Development Adviser to the Government of India, said that one of the most important measures which had been adopted to get cheap material was the survey of tracts to locate sites where fruit could be grown easily. Himachal Pradesh was the first tract to be surveyed. Other provinces would be surveyed likewise. The object was to make up the production deficiency and encourage 'one-variety' zones. Utilization in future would be linked with production. The Fruit Industry could take advantage of this survey and plan its future programme accordingly.

Dr Cheema added that measures were being taken to enforce provisions of the Fruit Products Order, particularly with a view to eliminating unfair competition with the genuine manufacturers. He informed the Conference that the demand for export of fruit products to Pakistan was very encouraging and permits for 1,82,000 lb. had so far been issued.

About 15 representatives of the industry attended the Conference which was presided over by Mr. K. W. P. Marar, Joint Secretary, Ministry of Agriculture.

ARTIFICIAL INSEMINATION TO STEP UP CATTLE POPULATION

ONE of the most amazing experiments ever attempted is nearing fruition at the School of Agriculture at Cambridge. A cow there will, in a few months, give birth to a calf to which she is not mother.

By using hormones and artificial insemination Dr Hammond, Director of the School, and his helpers have discovered means of making one prize cow have as many as 20 calves at one time. The prize cow does not give birth to the calves herself. While they are still in the egg stage—no larger than pin points—they are taken away from her and injected into a score of other cows which act as foster-mothers while the calves develop.

The cow at Cambridge would not take any prizes but the calves she is to produce will because both parents were of the finest stock.

This new development holds tremendous possibilities. Cows which cannot give more than a few pints of milk daily can be made to produce calves which will grow up to give yields of six or seven gallons daily. This will make it possible to improve cattle strains even faster than has been proved possible by artificial insemination where improvement from the male side is limited by the nature of the cow.

Even more remarkable methods are being evolved for increasing and improving the world's animal population. Research workers at Cambridge found that many animals judge whether or not it is mating time by the length of daylight. They experimented with various animals and found that sheep could be deceived by artificial lighting into having lambs well out of season. They believe that it is possible to make sheep have lambs twice a year instead of once and that if means could be found to apply the system on a large scale it could contribute greatly to the prospects of making a rapid increase in the world sheep population.

The results of the valuable work being done at Cambridge are available to all the world. (*B.I.S.*)

COVER ILLUSTRATION

Jute cultivators.

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 11
NOVEMBER 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.11.48
2,800

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department, (Publication Branch), India House, Aldwych, London, W.C.2.

INDIAN FARMING

NOVEMBER, 1948

Vol. IX No. 11

PROBLEMS OF INDIAN AGRICULTURE*

FRIENDS AND CO-WORKERS

I HAVE troubled all of you to come here to discuss important problems relating to agriculture which are of common concern to the whole country. I realize that all of you have left important work behind and have responded to my invitation probably at some sacrifice from the point of view of your local responsibilities. I would very much wish that some method may be devised which, while providing for the fullest consultation between the Centre and the provinces and States, should yet make the minimum call on the time of such a large number of Ministers and officials on whom naturally lies the burden of dealing with the day to day problems of their respective areas. But until such a method is devised, it becomes necessary to gather together at a central place from time to time all those whose advice and cooperation is essential before any large plans of national progress can be formulated and implemented. It is my hope that during these two days your joint discussions would result in concrete and practicable proposals and all that you would plan would be such as can be successfully achieved and within a limited time.

Four problems have been put down on the agenda of your Conference. These relate to

(1) proposals for stabilizing of prices of agricultural commodities and the machinery necessary for this purpose recommended by the Krishnamachari Committee,

(2) the organization of an Agricultural Census in 1950,

(3) the future Forest Policy in India, and

(4) last but not the least the programme of food production.

It is not my intention to take up the time of the Conference with any remarks either on the Krishnamachari Committee's proposals or the future Forest Policy in India. These two questions will no doubt be considered by you through the Committees which the Conference may like to appoint to deal with them. Since the invitation was issued for to-day's Conference, many factors have contributed to give to the problem of food production the highest priority and the public mind is considerably exercised in view of the difficulties created by high prices of essential commodities. One of the most urgent problems before the country is therefore to push forward the programme of food production with the maximum energy. I would therefore request you to give to the last two items earlier consideration and during the few minutes that I will be detaining you, I will confine my remarks to these two items which relate to our future programme for food production.

No country can formulate any plans of progress without an accurate idea of the existing state of things and the extent to which they affect the direction and rate of future progress. And yet when one tries to study the agricultural statistics of India, one cannot help feeling that one is dealing with data which is not wholly reliable. You know probably better than I do the methods and machinery by which the present agricultural statistics, specially those relating to foodgrains, are collected in the villages. On this foundation is built the super-structure of important deductions and on the basis of such deductions do we formulate our country's plans and policies. Scientific attempts to check up the accuracy of official estimates have shown large variations from 2 to about 20 per cent between the result of these two methods of calculation. It is high time that we re-organized our machinery for collecting accurate agricultural data and the proposal to India of the Food and Agricultural Organization of the United States to participate in the organization of Agricultural Census in 1950 is a welcome opportunity to put our statistical mechanism into good working order. It would be for you all who have considerable experience in this matter to formulate the necessary scheme for this purpose. But I may only venture to suggest that, lest cost prevents suitable action, fullest use should be made of such non-official agencies and organizations as may be serviceable for the great task involved in an agricultural census. It may be that some of these non-official organizations in the rural areas may need some training and guidance. That must be imparted to them in the briefest time possible by emergency training courses. These agencies and organizations will be and should be our constant helpmates hereafter also in our annual programme of collecting accurate agricultural data all over the country.

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* Speech delivered by the Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture at the Provincial and States Agriculture Ministers' Conference held at New Delhi on 8 and 9 September 1948.

I will now briefly deal with the main subject before you, viz. the programme of food production. On the food front nothing has been more often talked about than the so-called 'grow more food' campaign. The phrase was borrowed from other countries which during the war were planning to produce more food. In India the campaign was planned and executed by our predecessor Government at the Centre and Section-93 Governments in the provinces from the years 1943 to 1946. During these years a sum of Rs. 16,16,84,159 was sanctioned by the Central Government as loans and grants to provinces for this campaign which consisted of *ad hoc* un-coordinated schemes. Neither the present Central Government nor the Governments in the provinces and the States can take up any responsibility for acts of commission and omission of our predecessors. It has however been estimated that during this period over 70 lakh tons of different types of organic and inorganic manures and 3 lakh tons of seeds were distributed and nearly 50 thousand new surface wells were dug. It would seem that even if half this effort was actually put forth, it must have yielded some results and not been wholly a waste. But as I have indicated above, the condition of our agricultural statistics is such that it is difficult to suggest the quantum of increase of foodgrains due to the above programme. Be that as it may, the present Governments at the Centre and in the provinces and States can take up the responsibility only for the new five-year programme which commenced in 1947-48 when under Dr Rajendra Prasad, who was then the Minister for Agricluture, a more coordinated programme of food production was chalked out. For the last year the sums of Rs. 2,00,00,000 as grants and 1,36,00,000 as loans were sanctioned by the Central Government. It is expected that an equal amount was spent by the provinces. The provincial reports on the whole do not indicate the achievement of more than about 50 per cent of the target fixed for the last year. The main common difficulties which have been experienced are inadequacy of supply of coal, cement, iron and steel, fertilizers and machinery, apart from the delays caused in transport and in securing the sanction of the Central Government to provincial schemes. With regard to the last mentioned difficulty, I hope that the revised procedure will facilitate quick disposal of provincial proposals. The transport difficulty may, I expect, also progressively disappear. The non-availability in adequate quantity of articles for which we have to depend on foreign countries will, I am afraid, continue to be an important obstacle in our progress for a considerable time. The wisest plan seems rather to be, while expecting an improvement in these supplies from abroad, to plan our food production largely on the basis of such means and methods as are open to us within our own country. I have no doubt that with determined efforts backed by adequate financial support and organizational efficiency India can before long free itself from anxiety in regard to food.

But to enable India to achieve this result, agriculture must be allowed to come into its own and receive the priority it deserves in our nation's plans. Agricultural wealth is the basis of our industrial activity and national prosperity. Unless we spend more money and employ more manpower for the improvement and development of agriculture, we will continue to face uncertainties and put up with foreign dependence in a matter so vital as food. Many critics have placed before us constantly the achievements of American agriculture but we do not realize how incomparably vaster is the Governmental effort which supports the activity of the American farmer. Apart from the huge sums which each individual State provides, the Central Government of the United States spends, as I have stated elsewhere, a sum of Rs. 80 per person as against an insignificant one anna per person which our Central Government is able to use for the country as a whole. The Central budget can provide only 12 annas for agriculture out of Rs. 100 spent on the entire field of Government. A few years ago it ranged from four annas to eight annas out of Rs. 100. What do our Provincial Governments spend on agriculture although the major responsibility for agricultural development rests on them? In 1947-48, Assam spent on agriculture 1·5 per cent of its total expenditure, Bihar 4·2 per cent, Bombay 7 per cent, Central Provinces 3·2 per cent, Madras 4 per cent, East Punjab 2·2 per cent and the United Provinces 3·6 per cent. Even the Central Government in the United States has been spending a higher percentage than some of the Provincial Governments in India.

The amount of manpower which is behind agricultural production in India pales into insignificance when one compares it with a country like the U.S.A. For every 10 millions of population, the Central Government in India has only six Agricultural Officers whereas the Central Government in the U.S.A. has 408 Agricultural Officers, i.e. 68 times more than we have in India. Even the United Kingdom, a highly industrialized country employs under its national Government 120 Agricultural Officers for every 10 millions of its population, that is 20 times what Indian Central Government employs. Take a single example of that part of agriculture which deals with soil conservation. For this purpose the U.S.A. is divided into seven regions each under a Regional Conservator of the Central Government. Each region is sub-divided into soil conservation districts under District Conservationist. These District Officers are assisted by the Unit Conservationists and other subordinate staff. Each region has a staff of experts and specialized officers in charge of separate Divisions such as Operations, Agronomy, Engineering, Forestry, Biology, Plant Nurseries, Surveys, Irrigation, Land Management, etc. There are corresponding 'Divisions' in the headquarters of the soil conservation at Washington from which the work of the various sections of the Soil Conservation Service of the U.S.A. is directed. A host of officers and other staff permeate the separate States under the State Governments and with the help of numberless intervening non-official links bring to the individual field of the American farmer the benefits flowing from central research.

I feel that even if we overcome other difficulties and remove other bottlenecks a great deal is going to depend upon the manpower which we can marshal for agricultural improvements. We must create a series of links between the headquarters of the Government departments and the cultivator. Some work in this line, I know, has been done in one or two provinces, but it needs to be vastly and rapidly increased. We have in the villages of this country a lakh and a half of cooperative societies with a working capital of over 30 crores. Can we not mobilize all this manpower and divert the main energies of these societies to the programme of food production? Can we not utilize them as the agents of Government for such agricultural improvements as are independent of importation of foreign machinery or fuel oil or fertilizers which cannot reach us in due quantity and in due time? Can we not with their help stud the rural side with numberless small seed farms under registered growers so as to multiply improved seeds in the briefest time possible and distribute it easily over the widest area? Can we not employ their services for our entire programme of green and dry organic manure and also such fertilizers as are to be used for the production of food? Will they not be the best instruments for a programme of loans for agricultural improvements borrowed from provincial Cooperative Banks which would in turn receive advance from the Reserve Bank of India earmarked for agricultural development? Cannot these cooperative societies function as the propagandists of Government carrying the message of agricultural research and reform to the semi-literate and illiterate cultivators? Cannot these cooperative societies be availed of for creating part-time staff who will receive training and in turn train the agriculturists? Can they not also be made a reliable link even for the collection of agricultural statistics and the formulation and implementation of developmental plans? I would respectfully submit to the Ministers of Agriculture present to-day that it may be of some value if they can summon special cooperative conferences within their territories to mobilize rural cooperative societies and convert them into food production organizations. A programme of doubling these rural cooperative societies within the next year or two would be a valuable aid to our production plans.

I have begun to believe that the key to agricultural progress in America and some other Western countries is not so much mechanization or other modern methods of agriculture as the widespread human agency working away at the organizing of agricultural development. Whatever may have been our plans in the past and whatever may be the plans we may formulate to-day or hereafter, they will not, in the present condition of the Indian agriculturists, fructify to the full unless a large number of whole-time and part-time official and non-official workers enable the millions of India's cultivators to put these plans into action. To the extent we supply this need of the Indian cultivator to that extent shall we have made India self-sufficient, if not surplus, in regard to food.

The partition of the country has left us with greater proportion of population and lesser facilities for agriculture. We have retained 77·7 per cent of undivided India's population but only 73·1 per cent of the area, 72·5 per cent of rice acreage, 70 per cent of wheat acreage and 70 per cent of irrigated area. This has created additional difficulties for the Indian Union since 1947 and yet the example of a country like China can help us to realize that even this reduced area can maintain a much larger population. In the Indian Union only half an acre is under foodgrains per person, but in China only one-fourth of an acre is under foodgrains and yet China supports a population which is probably 40 to 50 per cent more numerous than ours. As you well know several countries produce three times the quantity of wheat and paddy per acre which we in India produce. The fear that India's population is beyond its food production capacity is based on the assumption that agriculture in India is ever to remain in a static condition. The example of other countries shows that each acre in India can produce at least three times what it is producing to-day.

Vast areas of waste lands in our country need reclamation by mechanical means. Large schemes of irrigation are under execution. These all need to be pushed through. But they would inevitably take some time. But dotting our country with rural organizations composed largely of cultivators themselves, through which our plans for agricultural development based on the means and methods available in the country can be implemented, is not a programme for which we need very much depend upon the aid of anything from foreign countries or await the passage of 5 or 10 years. Completion of this programme is almost entirely a question of our own action and rests on how far the popular Governments of the country can enthuse and inspire into our own people a high pitch of speedy endeavour. I do not know whether my suggestion would appeal to you but I feel that in the present situation of the country it will be better if we give most of our time during these two days to thrashing out our plan of action for the next year in regard to production of food. The proposals made by the Krishnamachari Committee and the dissenting minutes recorded by some of its members as also the future Forest Policy in India are for your open-minded examination and the free advice which you give in regard to these matters would also be very carefully considered. But as has been said, first thing must come first and so I hope that the vital problem of making India self-sufficient in food would be given prime importance at this Conference. As a matter of fact, we may even consider whether provinces should not so plan their food production programme as to be independent of any aid from the Centre by 1952 except under circumstances of an unexpected natural calamity. I do not know how far such a proposal would appeal to you, but I submit it to you for your discussion.

I find I have taken more of your time than I had proposed. I am grateful to you all for your response to my invitation and I am hopeful that your strenuous efforts during these two days will, as I have said above, and in a concrete and practical scheme for food self-sufficiency in India.

Original Articles

AGRICULTURAL RESEARCH: A REVIEW*

By R. L. SETHI and I. B. CHATTERJEE

THE Indian Council of Agricultural Research has now been in existence for well nigh 20 years. The Royal Commission on Agriculture recognized that the problem of improving agriculture was really the problem of improving the village life and this must be studied as a whole. The Council kept this point in view and on the one side it organized widespread ramification of coordinated research and on the other it subsidized village project schemes embracing important aspects connected with agriculture and animal husbandry in the villages. These schemes on the one side emphasized the importance of scientific aid to agriculture and on the other were so conducted that they have led to a substantial increase in the income of the cultivator. As a matter of fact wherever these schemes have been tried the neighbouring cultivators have also been enthused to adopt many of the methods.

It is difficult to present in a small compass all the varied activities in which the Council has been engaged since 1929. Only a brief description taken at random of some of the more notable items will be given here just to present an idea of the nature and quality of the work that has been and is being conducted under its aegis.

Rice

In the field of crop production rice occupies the foremost place. The Council gave great impetus to its improvement by subsidizing a chain of schemes at Berhampore, Cuttack, Chinsura, Nagina, Raipur, Habibganj, Bombay, Madras, Mysore, Kashmir, Travancore and Baroda. The major number of these schemes terminated between 1941 to 1945. As a result of investigations on the breeding side, a large number of varieties have been produced which are suitable for varying conditions, such as high and low-lying areas, suitable for resistance under flood, drought and saline conditions, resistant to the attack of insect pests, diseases and so forth.

In parts of Central Provinces and Bihar the evolution of purple-pigmented varieties has solved the menace of wild rice weed which was indistinguishable. This has led to a saving of about 20 lakhs of maunds of paddy equivalent to at least 60 lakhs of rupees in the Chattisgarh Division alone, whereas the cost of research was about a lakh of rupees. The percentage increase amongst the important varieties has been 20 to 25 per cent in Bihar, 30 to 52 per cent in Orissa, 17 to 23 per cent in Travancore and 55 to 70 per cent in Kashmir. The results in Bengal and Madras have also been of similar order.

Wheat

In wheat the most intriguing problem has been that of rust, which recently devastated a large area in Central India, Central Provinces and Berar, Bombay and Hyderabad, etc. during 1946-47. In Central Provinces and Central India the entire crop was lost leaving nothing even for seed purpose and in the former province, the Government had to import 40,000 tons of wheat for distribution as seed. The situation had become so serious that three meetings were called by the Government of India and held at Delhi to consider measures of control and a Wheat Rust Control Committee with the Agricultural Commissioner with the Government of India as a convener

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*This article contains a brief review of agricultural research carried out under the auspices of the Indian Council of Agricultural Research.

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was formed. The Indian Council of Agricultural Research also convened a special Wheat Rust Committee in December 1947 in Delhi and again in the Crops and Soils Wing meeting held in April 1948 in Madras.

There are three types of rust, viz. black, red and yellow, each having several physiological races. These physiological races (for each type of rust) cannot be distinguished from their outward morphological characters. Their main difference lies in the power of attacking different varieties and strains of wheat or other cereals and/or plants. The problem here is to evolve by breeding, hybridization, etc. such strains as will be immune or resistant to one or more or, if possible, all of the physiological races. The Council has for the last 18 years (since 1930-31) been subsidizing a comprehensive scheme of research on this highly important work. Although the results have not reached the final stage yet it has been highly instructive. The study on the life-history of the different rusts along with their behaviour on alternate hosts, have thrown much light on their possible role. The work suggests that the persistence of rust from year to year is probably not due to alternate hosts but to the over-summering of the disease on volunteer (i.e. self-sown) crop and early-sown wheat in the hilly areas of Nepal in the North and Nilgiris in the South. The disease from there is carried by wind to the plains where the standing crop is infected resulting in bad years, the complete destruction of the entire crop. In normal years the loss may be about five per cent involving about six crores of rupees in both Indian Dominion and Pakistan. The ameliorating measures lie in breeding rust-resistant types and adoption of control measures. In both these the Council is concentrating attention. In this connection work has been going on in Bombay, Central Provinces, Central India, Simla, Bhowali, Karnal and Agra.

Millets

In connection with investigation on millets under the aegis of the Council the results show in the case of *jowar*

(i) an increase of 20 per cent yield of *jowar* in areas of scanty rainfall by dry farming methods,

(ii) control of fungus attack of *jowar* by treating the seed with copper sulphate and powdered sulphur, and

(iii) control of *jowar*-borer by mechanical methods of cleaning the stubbles after harvest and burning them.

In addition to these, investigations on control of *jowar* Striga is also in progress. *Jowar* malt has been produced and its use as a supplementary food for infants has been suggested.

In respect of maize which is a highly prolific crop, it can play a very important role in making good the deficit in our food supply if arrangements can be made for the production of hybrid maize seed. Considerable work, both of fundamental research and production of hybrid vigour on a commercial basis has been done in America. Work has been initiated under the grants of the Council at the Indian Agricultural Research Institute and in important maize-growing provinces in India. Some work was also conducted under its grant at Lyallpur now in Pakistan.

Coordinated schemes have also been started on *bajra* and *ragi*, etc. yielding useful results. Trials in Baroda with *bajra* have yielded as high a yield as 731 lb. as against 531 lb. (local). In Mysore they have recorded 30 per cent more yield over the local variety. In Mysore some exotic *oodule* (millet) has yielded 1,520 lb. as compared to 360 lb. of local varieties.

Pulses

In the case of pulses India is very rich in species and varieties. In view of the bulk of the population being vegetarian and in order that the urgent protein requirements of the people can be met from this source, at the recommendation of Sir John Russel, the Council initiated a coordinated research scheme in almost all provinces and States, on grams, horse-grams, *arhar*, *mung*, *guar*, peas, *urd* and other pulses. Already important results from different places have been obtained ; for instance in Poona, eight selected varieties of gram have given 10 to 30 per cent increase over local type. In Central Provinces one variety gave 726 lb. per acre against 226 lb. and another 1,100 lb. against 818 lb. of the control. A study of the protein content has shown that the white-seeded gram has the highest percentage of protein (23 per cent) whereas the bold-seeded variety has 20 to 21 per cent and brown-seeded variety 16 to 17·5 per cent. Wilt is a severe disease which causes considerable damage to this crop. Work has been in progress in many places to evolve varieties resistant to this disease. Successful results have been obtained in some centres. In the case of *arhar* which is also susceptible to wilt it has been found that when it is mixed with *jowar* the incidence of wilt was much reduced, the mortality in *arhar* being 32 per cent as against 88 per cent when *arhar* was sown alone as a single crop. Mixed sowing has thus proved of great advantage.

Oilseeds

In oilseeds high-yielding strains have been evolved in schemes sanctioned in different provinces and varieties with higher percentage of oil have been obtained.

In Madras in the case of groundnuts selection No. AH 678 yielded 10 per cent more than AH 25 and was found superior in shelling percentage and weight-volume relationship. It also gave a saving of 25 per cent in the seed rate as its kernels are smaller in size.

Fruits

The importance of fruits requires no emphasis in a country like India, and here the Council has been subsidizing schemes in Madras, the United Provinces, the Punjab (now East Punjab), Bihar, Bengal (now West Bengal), Central Provinces, Assam, Hyderabad, Mysore, Coorg, etc. Investigations are carried out on various types of fruits such as mangoes, papayas, peaches, banana, etc. Fruits require a long range investigation and sometimes years must lapse before practical results can be expected. The Council has a Fruit Development Adviser to advise on fruit research.

In the Punjab in regard to the quality of Malta orange it was noted that the quality of the fruit in respect of soluble sugars and acidity was greatly improved by the application of ammonium sulphate and farmyard manure.

At Chaubattia phosphates increased the vigour of apples significantly.

Some mention should also be made of the work on cold storage, preparation of recipes and syrups, cordials, juices, candy products, etc. Canning of fruit and preservation of fruits, is conducted in Madras and at the Indian Institute of Fruit Technology in the Punjab, now at Delhi.

Potatoes

Due to the initiative taken by the Council there has been valuable collection of potato varieties in Simla. Many of them have been brought from their original home in South America (Chile, Peru and Bolivia). These have formed material for evolving improved types by hybridization. Work on potato has been conducted from various points of view, one of which deserves special attention, viz. the development of tuberless sowing, by which immense saving of seed can be possible. Each tuber is capable of producing 20 to 40 plants by this method. The investigation of potato will be passed on to the Indian Central Potato Institute.

In view of the recommendations of the Famine Inquiry Commission the Council has also initiated measures to develop other root crops like sweet potato, tapioca, etc.

Fodder crops and grasses

For improvement of these crops the Council has sanctioned combined Agricultural and Animal Husbandry Research Schemes in different provinces and States.

Manurial experiments

On the manurial and cultural side the investigations initiated by the Council have led to results of enduring value. One of the first work that the Council undertook soon after it came into being was the examination of the previous manurial experiments conducted all over India. These have since been embodied in voluminous publications and also bulletins and papers. These experiments however suffered from the fact that in those days the modern statistical methods were not known and the designs of experiments did not permit critical examination. Since then at the initiative of the Council manurial experiments on statistical basis have been undertaken in all the provinces and States thus giving more reliable basis of information. In this connection investigations have been conducted with organic and inorganic manures, farmyard manure, cattle-dung, compost, oilcakes, etc. Along with these, chemical fertilizers have been tried and in all some 5,000 manurial trials have been conducted, on various crops including paddy, wheat, *jowar*, groundnuts, millets, and other oilseeds and pulses. The most important conclusion is the great need for the application of nitrogen in some form or other. There is no place where the application of nitrogen has failed. Under irrigated conditions, wheat showed a universal response to nitrogenous fertilizers and manures. Under unirrigated conditions there were fluctuations but in spite of these the tendency was for a general response. In the case of paddy 20 lb. of nitrogen per acre appears to be minimum dose and there are indications that the doses can be profitably increased to 60 or 80 lb. in areas where the level of fertility is high. Oilcakes have been found as good or often better than ammonium sulphate. The increased yield through ammonium sulphate has varied from 21 to 24 per cent in Bengal to 70 per cent in the United Provinces and Kashmir. With oilcakes the maximum increase has been as high as 110 per cent, 120 per cent, 150 per cent, and even 190 per cent.

Considering that in green manuring the cost of nitrogen is only a fraction of its cost as compared to other manures like inorganic fertilizers or oilcakes, the practice of green manuring has been encouraged in all areas where water supply is assured and particularly in irrigated areas. An application of 30 to 40 lb. of nitrogen through green leaves is likely to increase the yield by 22 to 30 per cent whereas heavier doses of 60 to 80 lb. of nitrogen have given in certain cases over 100 per cent increase.

The investigations further point that there is no critical evidence to show that repeated application of the fertilizer without organic manure does harm to the soil or that repeated applications of ammonium sulphate alone over a series of years cause a fall in the yield.

In Bengal a manurial schedule has been worked out at six different price levels of paddy and four levels of ammonium sulphate. The schedule shows that manuring is paying even at the peak price of ammonium sulphate at Rs. 250 per ton if the price of paddy at Rs. 5 per maund is assured and moreover, of the two doses, viz. 20 lb. and 40 lb. of nitrogen per acre the double dose is more remunerative. In the case of some of the other provinces statistical equations have been worked out for forecasting the possible return under certain sets of conditions.

In the case of wheat manurial experiments have given increased yield varying from 6 to 63 per cent.

The experiments were not generally confined to the limited objective of only finding out the nature of response under different doses. Investigations in many cases included other important matters. Thus it was found in Central Provinces in the case of wheat that ammonium sulphate was very effective when applied with seed whereas sodium nitrate was best at top-dressing. The drilling of fertilizers further showed that the response per unit of fertilizer was double as compared to broadcasting. In the case of *jowar* the trials at Poona suggest that the application of nitrogen at sowing time is preferable to later application. Trials at Coimbatore on *jowar* showed that there was a depression in yield by the application of inorganic nitrogen or phosphate singly but there was a phenomenal increase obtained by joint application of nitrogen and phosphate, the increase being largest on poor land. In the case of *ragi* also it has been found that phosphate is an essential supplement to nitrogen under rain-fed condition in Mysore. At Dharwar in the case of *jowar* the response to oilcakes was increased threefold or more when they were applied on a basal dressing of farmyard manure. In Bihar where the soil is generally deficient in phosphate the response to phosphate under wheat takes place only when it is added as a supplement to nitrogen. In the black soil tract as well as in the Gangetic alluvium under irrigated conditions on wheat, August has been found to be the best month for applying farmyard manure and is to be preferred to October. It has been further found that a combination of organic and inorganic nitrogen is more effective than either applied singly and that bulky manures like farmyard manure, cattle-dung, compost, etc. have a lower efficiency of nitrogen as compared to that of oilcakes.

Green manuring experiments on wheat in the United Provinces show that ploughing of sann after seven to eight weeks' growth and *guara* after 12 weeks' growth was better than burying earlier and that if sann was allowed to manure by burying there was a depression in yield. Experiments at Lyallpur showed that green manuring supplemented by 10 lb. of nitrogen as ammonium sulphate gave per acre more grain than green manuring plus 10 lb. of nitrogen as sodium nitrate. In the case of groundnut there was an appreciable response to nitrogen from ammonium sulphate but its application at sowing time yields better results than divided application. It has been found in the Punjab that correct spacing may increase the yield by 25 per cent. The response of groundnut to a combination of nitrogen and phosphate was considerable in Madras, Bombay and Central Provinces.

An interesting feature has been found in the case of linseed both in Central Provinces and the United Provinces. There was little or no response to nitrogen or phosphate singly or in combination with cattle manure. It is proposed to investigate the cause of this. In the case of *toria* it has been found in the Punjab that ammonium sulphate at 40 lb. of nitrogen per acre applied half at sowing time and half at flowering produced 1,026 lb. against 700 lb. in unmanured plot. It has been further found that if in the normal rotation in which *toria* follows wheat, the land is green manured with *guara* before sowing wheat the yield of *toria* is considerably increased due to the residue of green manure.

In the case of fruits it has been found at Sabour that ammonium sulphate and farmyard manure applied on mangoes after harvest gave significant increase in flowering in the following season and that nitrogen significantly increased growth.

It has been found in Madras that biennial bearing in mangoes is not the inherent feature of most of the varieties and optimum crops can be secured every year provided the tree in the preceding season has made normally vegetative growth.

Other work

The other work of the Council includes soil survey, investigation on dry farming, agricultural meteorology, village project scheme, All-India Compost Scheme, investigations on medicinal and other miscellaneous plants, etc.

As regards soil survey the Council decided that before a comprehensive soil investigation was undertaken all existing information on the different soil types occurring in India should be collected and collated. Accordingly the All-India Soil Survey work was started in 1942 and the information thus collected is now ready for publication. In agricultural meteorology the Crop Weather Coordination Scheme deserves special mention. This work contemplates organization of a net-work of stations for detailed observations of crop growth, yield and environmental and weather factors to build up crop weather statistics on scientific lines. Questionnaires were circulated to the districts and according to the replies received, crop weather calendars have been prepared for each important crop. These are of great value to the weather forecasters in issuing the *Farmers Weather Bulletin.* On this basis the weather services for agriculture have commenced with the issue of daily *Farmers Weather Bulletin* in Indian languages through All-India Radio.

It will be seen from the above that since the inception of the Council, work of far-reaching magnitude has been undertaken and the results so far achieved have been of a very high order. It may of course be asked as to how far results achieved have been adopted in the country. Here also the Council has tried within its limited funds to initiate organizations for work like seed multiplication but the major part of this work devolves on the provinces and States and it can be reasonably expected that as days pass this will be taken up more and more vigorously. A large number of newer problems are also awaiting solution and the schemes on some of them are already under consideration of the Council.

In order to keep the work up-to-date the Council has been inviting experts from abroad to review the work in progress and lay down lines for future guidance. Sir John Russel visited the country in 1936-37 and his report has since served as a useful guide to the Council for sanctioning schemes in different parts. Dr Shuhart was invited in 1944 to advise on soil conservation of the country. Now Dr A. B. Stewart of the Macaulay Institute for Soil Research, Aberdeen, who was invited to make a report on the soil fertility investigations in India with special reference to manuring, has suggested ways and means of bridging the gap between research and practice and the Council is considering a scheme to implement his recommendations.

The Council has also launched a model scheme to develop 20 villages in Delhi province by coordinating work of different aspects on agriculture and animal husbandry. This is likely to serve as a guide as to how by the development of agriculture other aspects of rural life which are so intimately linked up with it can be improved.

The total number of schemes which have been so far financed by the Council exceeds 200. On the agricultural side the total amount involved is 1·02 crore rupees.

It may as well be asked as to what value has been obtained from the expenditure of such an amount. It will however be seen from the description given in the foregoing that improved strains to suit different conditions of soil and climate have been evolved in rice, wheat, and other crops. In view of the limited funds allotted to the agricultural research compared to some of the more progressive countries of the work, the progress here could not be as much as should have been but in spite of it the results have been really considerable.

The increased yield due to improved varieties have varied broadly up to 25 per cent. But even if we make a conservative estimate of only 10 to 15 per cent of return, it will show how much it has been possible to achieve within the limited funds spent. The total estimated acreage of cereals and millets in the undivided India was of the order of over 200 million acres, out of which rice and wheat in the then India occupied about 81 million acres and 35 million acres respectively. If we take the case of only these two areas the estimated production is 27 million tons of rice equal to 739 million maunds and 9 million tons of wheat equal to 243 million maunds. If we assume only a very small increase, viz. only ¼ of a maund per acre due to improved varieties (actually it is considerably more and in some cases it exceeds double the normal yield) it works out to an extra yield of about 29 million maunds which even at Rs. 10 per maund offers a return of 29 crores of rupees. Compared with this the amount spent annually by the Council has been 0·56 crores and is expected to reach 1·025 crores when the schemes terminate.

As a matter of fact the amount annually spent on agricultural research in India has been very little, viz. about ¼ of an anna *per capita* per annum of 1/10th of an anna per acre of the total area. The total sum thus spent was less than two-third of that spent on agricultural research in the United Kingdom where the population was ⅛th and area only 1/20th of that of undivided India. It may be stated here that the Central Government of the present Indian Union in its budget for 1948-49 have allotted a much larger sum of about Rs. 20,250,000 for agricultural work and improvement. This works out at 11 pies *per capita* as compared to Rs. 2 for United Kingdom, Rs. 20-14-5 for Canada and Rs. 77-9-11 for the United States of America and the amount is only 0·8 per cent of the total budget expenditure of the centre. The provinces too have allotted a higher sum and it is indeed a happy sign that the improvement of agriculture is being gradually recognized. But in order that the problems can be tackled from all angles greater scope and larger funds are an urgent necessity.

EELWORM DISEASES IN PLANTS

By R. CHAKRAVARTI

WE are familiar with the roundworms, the nematodes, as the causative agents of a number of harmful diseases among human beings and animals. The plant pathologist is, however, interested in one family of the nematodes, the Anguillulinidae, owing to the fact that a number of worms belonging to this family are responsible for a large number of diseases among plants. Nematodes infecting plant life are commonly known as eelworms. They lead either an ectoparasitic or an endoparasitic life with reference to plants. These are usually very minute and except for a few enlarged females are hardly visible to the naked eye. While our knowledge of nematodes infecting human life and domesticated animals is vast, we know very little about the plant parasitic forms and the ravages they cause, especially in India. It is the aim of this article to present in a brief manner the most important plant diseases due to eelworms in India and to indicate the extent to which they are a menace to agricultural progress.

Root-knot disease (*causative agent :* **Heterodera marioni**)

A study of this disease is interesting because of its distribution in the tropics as well as the temperate regions of the globe and because of its wide range of host plants. It has been recorded in a number of places in South India, especially in the southern part. This disease is believed to be natural to the tropics and was spread later on to the cooler regions of the world and has been recorded in England. It has a very wide range of host plants and is known to attack 500 wild and cultivated species. It has been recorded in South India that many plants of economic importance are attacked and the damage caused is considerable in several cases. *Bhindi* (*Hibiscus esculentus*), *gogu* (*Hibiscus canabinus*), green gram (*Phaseolus aurens* Roxb.), Bengal gram (*Cicer arietinum*), Black gram (*Phaseolus mungo*), Horse gram (*Dolichos biflorus*), Lucerne (*Medicago sativa*), Clusterbean (*Cyamopsis psoraloides*), etc. are abundantly infected. Cowpea (*Vigna catjang*), pumpkin (*Cucurbita maxima*), groundnut (*Arachis hypogea*), chilly (*Capsicum annuum*), Backyard bean (*Dolichos lablab*), linseed (*Linumusitatissimum*, Linn.), *ragi* (*Eleusine coracana*), coriander (*Coriandrum sativum*), etc. are mildy infected, while Cambodia cotton (*Gossypium hirsutum*), castor (*Ricinus communis*), red gram (*Cajanus cajan*), Safflower (*Carthamus tinctorius*), maize (*Zea mays*), sunn hemp (*Crotolaria juncea*), paddy (*Oryza sativa*), *cambu* (*Pennisetum typhoideum*), *cholum* (*Sorghum vulgare*), etc. are free from infection. Still we are in doubt as to the exact range of host plants. Experiments on this question show that among the host plants, species of plants belonging to widely different families are noticed while some closely related species exhibit difference in their susceptibility. The external symptoms are not uniform. While some infected plants are unhealthy, others have normal growth. It is supposed that the susceptibility is dependent not only upon the specific characters of the plants, but also upon some external factors, such as soil, climate, and the host-history of the parasite.

Symptoms and effects: Plants affected by the disease usually exhibit the following symptoms in the aerial parts. The plant presents a sickly appearance; the leaves wilt in the hot season readily. The leaves are of a pale green colour and degeneration of tissues in the margin, known as marginal necrosis, may be noted. The plant has a dwarfish appearance and slower growth. In most of the diseased cases the seedlings are killed as soon as they make their appearance, and even if they succeed in developing, they die before reaching maturity. Owing to decreased vitality, the yield is poor. The fruits, if produced, are unhealthy. They may also be infected in some cases if they come in contact with the soil.

The stem symptoms may or may not be seen, and even if they are seen, they may be

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attributed to other causes; but surprising changes are seen in the root system. The affected roots become two or three times as large in diameter at certain places as the normal roots and finally decay. The roots in this condition are said to be 'galled'. A cross section of the galled root shows several spots in the pericycle where the tissue has disintegrated. These are known as the 'necrotic spots' and contain the pathogene. The malformations, though rounded usually, are in many cases grooved with cracked surfaces. In cases of severe infection, the roots may be beaded in appearance. The galls may sometimes attain a large size and cases are on record where the gall was as big as a duck's egg. The roots may be swollen throughout with dirty patches of rotten portions. The galls in some cases may coalesce resulting in distorted or mis-shapen root system, with the fibrous roots reduced to a minimum. The roots may finally decay and die.

Tubers are also sometimes attacked. The tuber presents a warty appearance, and there are a number of pimples on the surface. Below each pimple in the tissue of the tuber are seen necrotic spots. In the centre of the necrotic spot may be seen the female of the pathogene, a pearly white body of the size of a pin-point. In severe cases the entire tuber may decay and die.

This eelworm is said to be the carrier of certain fungous and bacterial diseases; for example, it is the only carrier of the disease in cereals due to *Dilophospora alopecuri*, (reported from Bulgaria). The eelworm may also increase the susceptibility of certain plants to disease.

In some cases the eelworm and a harmful fungus may associate themselves to produce disastrous results. Such relationship has been studied in England between *H. marioni* and *Colletorichum tabificum.*

Life-history of the parasite: The enlarged female may be seen in the necrotic spots in the gall. The female lays about 400 eggs and soon after, the male and female die. The eggs on germination give rise to the larvae which even at this stage have a characteristic organ called the 'buccal spear'. The larvae may attack other portions of the same root causing galls or escape into the soil either leading a free life in the soil or attacking other roots. The larvae attack the host by piercing the cells with the buccal spear. The buccal spear is an accessory organ with all plant parasitic nematodes. It is placed in the buccal cavity of the parasite and can be protruded by means of powerful muscles. It has a base consisting of three or six knobs and a cylindrical stem tapering to a fine sharp point. It has a fine pore running throughout its length and functions as a physician's syringe, sucking up food and introducing certain toxins into the host cells. These toxins induce a condition known as 'hypertrophy' consisting of cell-enlargement and cell-multiplication and the galls and malformations already described result. The mechanical injury by the buccal spear seems to be negligible when compared to the toxic effects.

It is generally supposed that the larvae are capable of infecting fresh roots. The egg is said to be the most resistant stage. It has been found that the larvae can lead a free life in the soil for about sixteen months seemingly without food. The larva is sensitive to temperature and thrives well at a temperature of 55°F. Its thermal death point is between 120°F. and 140°F. It is inactive below 50°F. Complete drying will kill it in three minutes. It is supposed to thrive well in light and sandy soils and has no chance in clayey soils and an acid soil is said to favour it. In South India the disease has been observed to be very severe between August and February. In short, all conditions leading to a better and healthy produce seem to favour the parasite. The parasite has very little powers of locomotion and is said to be transmitted by the flow of water from place to place (including irrigation), transport of such movables as farm implements, etc.

Control: No system of effective and cheap method of permanent control seems to have as yet been evolved. On a limited scale the infected land may be sterilized by means of steam or hot water. Flooding the field for two or three months is also said to kill the parasite. The use of a catch crop has also been suggested A very susceptible crop is (in this method) grown in the infected land and before the larvae are liberated the plants are uprooted and destroyed. Breeding of nematode-resistant plants is also suggested. The possibility of killing the eelworm by a predaceous nematode, *Monnonchus papilatus*, has also received consideration. Yet another method is to leave the land uncultivated for two years, care being taken to see that no susceptible weed thrives in the meantime.

Besides these, for South Indian conditions, two methods have especially been recommended. The first is soil sterilization by the use of nemacides. The Madras Agricultural Department conducted a course of experiments on the relative efficacy of the following chemicals in reducing the nematode population of the soil: a mixture of potassium cyanide and ammonium sulphate, calcium cynamide, sulphur, ammonium carbonate and calcium cyanide. As a result of these experiments it was found that a mixture of potassium cyanide and ammonium sulphate (in the proportion of 800 lb. of the former to 1,000 lb. of the latter per acre) would be most suitable for the purpose, under South Indian conditions*. Calcium cynamide (1,000 lb. per acre) was also found to give good results. It has however been pointed out that the use of nemacides on a field scale may be out of question for economic reasons.

The second method is rotation of crops using a resistant crop. The resistant crop should pay for the cultivation and should have a dense growth so as to leave no chance for susceptible weeds to thrive. It should not also impoverish the soil. Some of the plants suggested to be used as resistant crop are *cholam*, *ragi*, red-gram and maize.

Ear-cockle disease (causative agent: **Anguillulina tritici***)*

The chief host of this disease is wheat. Rye is also a susceptible crop. The disease manifests itself in the aerial parts of the host especially in the inflorescence, where instead of sound grains we get galls. The disease has a very wide distribution. Europe seems to be its original home. In India it is prevalent in the Punjab where it goes under the vernacular names, *mamni*, *dhanak*, *gegla*, etc.

Symptoms and effects: Plants suffering from the disease present a sickly appearance, have stouter stems, and the leaves usually have an abnormal growth. They exhibit a wrinkling, twisting and rolling up, especially in the younger regions, and on them small rounded elevated bodies may be noticed. In the words of Byars, 'The young leaves become so strongly infected within the older leaf-sheaths, that instead of growing up straight normally, they may be forced through the latter carrying along with them the young stem. In this way, the stems are sometimes bent and induced to grow almost in a horizontal direction. The leaves become so wrinkled, twisted and rolled up so as to leave no semblance to their natural shape. The normal green colour disappears and finally after wilting the entire plant dies'.

The stem symptoms are not however so marked as those in the inflorescence, which usually becomes shorter, greener and has more widely diverging glumes. Instead of sound kernels we find galls, the gall being a light, brown, hard body, smaller and thicker than the normal wheat grains, difficult to break, having smoother but thicker walls and containing larvae of the eelworm. The inflorescence remains green, longer.

The injury consists in killing the seedlings as they come up and reducing the yield and the quality. In severe cases as much as 80 per cent of the seedlings may be killed and the yield may be reduced by 40 per cent. The quality of the produce is bad and the flour yield also poorer.

Life-history of the parasite: The disease is due to *Anguillulina tritici*, which may be found among its larvae in the leaf galls or in the flower galls, and as an ectoparasite in the leaf sheaths near the terminal bud.

If a flower gall is broken open, a yellow mass containing a number of larvae is found in the centre. The larvae fall to the ground along with the gall, and by the decay of the latter escape into the soil. They have a limited power of locomotion and attack the new seedlings and lodge themselves in the sheaths near the terminal portion and may produce the symptoms observed on the young leaves. The inflorescence is attacked as it comes up and the parasite gets into the flower, producing the gall. Inside the gall, the larvae mature and pair. The female lays about 3,000 eggs and soon after, the male and the female die. The eggs hatch into larvae and by the time the galls are mature they become dormant, and lie so till favourable conditions return.

The dormant larvae, especially those in the

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*The amount of cyanide has been taken from Krishna Ayyar's experiments (*Ind. Jour. Agri. Sci.*, III—6, 1933) conducted in pots. This accounts for the large quantity when calculated on acre basis. The handling of so much quantity is dangerous and is not likely to be permissible. The statement referred to is therefore subject to this reservation.

galls are very resistant to temperature and the action of chemicals, and can lie dormant for as long as ten years. The disease is transmitted chiefly by sowing galls along with sound grains, or by contamination of the soil with galls during the harvest.

Control : There are two possible methods : (i) Rotation of crops. In view of the limited range of hosts, this method may be adopted with advantage, and consists of growing a non-susceptible crop in the field for two years before returning to wheat.

(ii) Use of clean seeds. Seeds which do not have galls mixed with them may be used. The best way to obtain clean seeds is to get them from places where the disease is not prevalent. In case this is not possible, the infected seeds may be cleaned by the 'salt-brine' treatment. The mixture of the galls and sound seeds is poured in a 20 per cent solution of common salt and stirred vigorously. The galls and other impurities will float on the surface, and may be removed and destroyed. The clean seeds are rinsed in cold water and then in hot water at 50° F. for ten minutes. They are then ready for use.

Ufra disease (causative agent : **Anguillulina angusta***)*

The only host is rice. The disease does not seem to occur in any other part of the world except, Assam, Bengal and Malaya. The parasite leads an ectoparasitic life on the plant.

Symptoms and effects : Plants suffering from the disease usually have a stunted growth. The leaf sheaths have all sorts of discolorations. The stems possess characteristic lesions above the nodes in the internodal region for half an inch or so. The young stem becomes brownish or blackish, flaccid and shrunken and in several cases hardly more than a thread in thickness. The peduncles are withered. The ear is arrested in growth. It is also found to be sterile. The young blades while still in the sheath may also be attacked and fail to develop. It is said that the eelworms, pass through two or three generations while still in the host. The eggs are fairly large and numerous. The host is rarely killed, but in most cases is made sterile.

Exact figures as to the damage done are not available. In one case out of an area of 21 million acres nearly six million acres were heavily infected and the damage caused was nearly rupees two lakhs.

Life-history of the parasite : The parasite can breed and grow only in air of certain saturation. During the dry months of the year it lies dormant. The disease is said to be severe from June to December and the parasite is said to be capable of living in water for sometime away from the host. In low grounds, however, where the disease is most destructive, it is said to be prevalent throughout the year.

Susceptibility : Of the three varieties of rice grown in Bengal, *boro* or spring variety is grown between November and May and is free from the eelworm attack as it matures before the eelworms are ready to attack. The other two varieties, *aus* or autumn variety and *aman* or winter variety are both susceptible.

Control : The control of the disease is by growing more of the resistant *boro* variety and letting the land idle for the rest of the year. After the harvest the stubble may be removed and thoroughly burnt.

Bud-rot disease (causative agent : **Aphelenchus sp.***)*

This disease has recently been reported from Mysore, and is known locally as *hidimundige.* The host is the areca palm.

Symptoms and effects : To a casual observer no marked difference appears to exist between the healthy plant and the diseased plant. The leaves are gradually shed one by one till the entire crown disappears and only the bare stem remains. The process may take several years. In the early stages, discoloration of the unfolded leaves in the bud is noticed. This discoloration gradually extends downwards till the entire central spindle begins to rot and is converted into a soft evil smelling mass of tissue. The rot may extend to the very base of the stem. The rotten tissue on microscopic examination reveals the parasite and the eggs.

Life-history of the parasite and control : Nothing is so far known about the life-history of the parasite and the methods of control. The disease however seems to be infectious and one probable method of transport of the disease is by introducing seedlings from areas where the disease is prevalent.

MILK-CLOTTING ENZYMES FROM PLANTS

By NOSHIR N. DASTUR

MILK clotting enzymes are important in the manufacture of different varieties of cheeses. The best known enzyme regularly used for this purpose is rennet. Rennet is used for preparing most of the foreign varieties and some of the indigenous varieties of cheeses. The fact that a product obtained from animal source is used for making cheese does not appeal to those who are vegetarians. There are several advantages in making cheese. Cheese-making provides a good outlet for milk during surplus season when all the milk produced cannot be disposed of economically. Cheese is more easily digestible than other dairy products and gives a very nutritious food in a concentrated form. Being rich in first class proteins, it is a great advantage to include some cheese in the diet of the vegetarians. If the animal rennet used in the preparation of cheese could be replaced by an enzyme from some vegetable source, it should prove useful in making cheeses which are universally acceptable.

Enzyme for cheese-making

The enzyme that is used for cheese-making should not only clot milk but help to bring about other changes which give that desirable flavour to different varieties of cheeses. One of the most important changes is digestion of protein. In fresh cheese, hardly four per cent of the total protein is soluble in water. During the process of ripening, this increases and amounts to over one-third of the total proteins. Further, during ripening, various volatile acids, the esters and ketones of these acids are produced in small amounts which give the typical flavour. A suitable enzymic preparation from vegetable sources besides clotting milk should be able to bring about these desirable changes in cheese during ripening.

Plants with milk-clotting properties

In the vegetable kingdom, milk-clotting properties are exhibited by several substances derived from different sources. The following plants have been reported to have milk-clotting properties. The *Hindi* names of these plants, wherever known, are indicated within brackets.

1. *Andropogon schisenan*
2. *Anthriscus vulgaris*, Bernh
3. *Capsella Bursa —Pastoris*, Moench
4. *Carica papaya*, L. (Papaya)
5. *Centaurea scabiosa*, L.
6. *Crotalaria burhia*, Hamilt (*Ghugharo, Ghagari*)
7. *Ficus carica*, Linn. (*Anjir*)
8. *Ficus palmata*, Forsk. (*Gular, Khaleara, Beru*)
9. *Galium verum*, Linn.
10. *Geranium molle*, Linn.
11. *Lamium amplexicaule*, Linn.
12. *Leucas cephalotes*, Spreng. (*Dhurpi sag*)
13. *Lolium perenne*, Linn. (Rye grass)
14. *Medicago sativa*, Linn.
15. *Medicago lupulina*, Linn.
16. *Philadephus coronarius*, Linn.
17. *Pinguicula vulgaris*, L.
18. *Plantago lanceolata*, Linn. (*Baltanga*)
19. *Ranunculus bulbosus*, Linn.
20. *Rhazya stricta*, Dene. (*Sunwar*)
21. *Solanum elaeagnifolium.*
22. *Streblus asper*, Lour. (*Siora, Rusa, Daheya*)
23. *Withania coagulans*, Dunal. (*Akri, Panir*)
24. *Withania somnifera*, Dunal. (*Panir, Asgandh*)

Amongst these, properties of only the following have been tested and some of them actually used for the preparation of cheese:

(1) *Carica papaya:* The enzyme is obtained from the juice of the unripe fruits. It is best to collect the juice in the mornings as the flow is then more copious. This juice is carefully dried and ground. The enzyme is a very powerful protein-splitting one. No work has been carried out to use this enzyme for cheese-making. On account of its known proteolytic activity, the enzyme by itself will not be very useful but in combination with some other material may give good results.

(2) *Ficus carica:* The latex of edible fig

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tree is found to contain a powerful milk-clotting enzyme. The enzyme can be concentrated by directly drying the latex or by precipitating with inorganic salts or organic solvents[1]. It is possible to obtain preparations, one part of which could clot 1,000,000 parts of fresh cow milk at 37°C. The optimum temperature of this enzyme is 76°C. and by carrying out the reaction at this temperature, a twelve-fold increase in activity is observed as compared to the results at 37°C. The activity is further increased by adding calcium to milk. The enzyme is able to break down casein and other proteins. When used for making cheese, it is found that the cheese gives a bitter taste after ripening, but it may be possible to remove this defect by further purification of the enzyme.

Krishnamurthy and Subrahmanyan[2] describe one very interesting property of papaya latex. It is able to clot vegetable emulsions from soyabeans and groundnuts in contrast to animal rennet which failed to clot such preparations.

(3) *Solanum elaeagnifolium:* The enzyme is contained in the berries of the plant. The concentrated enzyme is prepared by extracting the berries with five per cent of common salt and then precipitating the enzyme from the clear extract with thirty volumes of acetone. The optimum temperature of the enzyme is about 80°C. to 85°C. As the temperature is increased from 37°C. to 85°C., the activity of the enzyme increased four-fold.

(4) *Streblus asper:* It is a shrub found in many places in South India and specially near the foot of Kodaikanal Hills, in Bellary, Coimbatore Districts and Malabar. The milky juice of the plant produces rapid coagulation of milk giving a firm curd. No systematic studies seem to have been carried out so far to study the various properties of *Streblus asper* enzyme. In view of its powerful milk-clotting property, further investigations should give interesting results.

(5) *Withania coagulans:* The enzyme material is obtained from the berries of this shrub which grows wild in scattered localities in Campbellpur, Mianwali, Multan and Muzaffarnagar Districts of the Punjab and in the N.W.F.P. around Nowshera. The active material is contained in the gummy matter embedding the seeds. The ripe berries are sold in the market at the places named above under the name *Panir dodi*. Sheridan Lea[3] first indicated the possibility of using this material for preparing cheese. This material has been extensively studied in recent years. Kothavalla and Khubchandani[4] used a saline extract of the berries for preparing *Surti* cheese and *Cheddar* cheese. The hard cheeses were found to develop an open texture on storing. Narain and Singh[5] succeeded in getting an active material by precipitating the enzyme with alcohol. One part of this enzyme was able to clot 26,000 parts of milk at 30°C. These workers also studied the properties of their preparations in detail and used it successfully for making *Cheddar* cheese.

Recently, extensive studies have been carried out with the enzyme from *Withania coagulans* at the Indian Dairy Research Institute under the aegis of the Indian Council of Agricultural Research. It was found that amongst all the parts of the plant examined, the pulp and the husk of the berries alone show milk-clotting properties. The most convenient method of isolating the enzyme is by extracting the berries with water and then precipitating the enzyme by adding two volumes of acetone, and drying the precipitate at low temperature. The enzyme prepared in this manner is quite stable under ordinary storage conditions. The optimum temperature of the enzyme is between 45° to 60°C. At higher temperatures than 70°C., the activity of the enzyme decreases rapidly and it is completely inactivated at 80° C. The activity of the enzyme also increases with the increase in the acidity of milk. Addition of calcium to milk is found to greatly enhance the activity of the enzyme. It has been shown that the enzyme does not hydrolyze proteins. Boiled milk takes a longer time to clot but it is possible to restore the clotting ability of milk by addition of calcium. *Withania coagulans* enzyme is non-toxic. Under optimum conditions, it is estimated that one part of the vegetable rennet will coagulate nearly 90,800 parts of milk in 30 minutes.

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[1] Krishnamurthy, C. R., Jaganathan, V. and Subrahmanyam, V. (1946). *J. Sci. Ind. Res.*, **4**, 720.

[2] Krishnamurthy, C. R. and Subrahmanyan, V. (1947). *Current Sci.*, **16**, 253.

[3] Lea, S. (1883–84). *Proc. Roy. Soc.*, London, **36**, 55.

[4] Kothavalla, Z. R. and Khubchandani, P. G. (1940) *Indian J. Vet. Sci.*, **10**, 284

[5] Narain, R. and Singh, A. (1942). *Indian J. Vet. Sc* **12**, 224.

One interesting point of difference between animal rennet and the enzyme from *Withania coagulans* was noticed in studies with diluted milk. When milk diluted with an equal amount of water is used for coagulation test, it is found that enzyme from animal source requires same or slightly more time to coagulate milk. On the other hand, with vegetable enzyme under identical conditions, a considerable decrease in the coagulation time occurs.

Using the concentrated enzyme from *Withania coagulans*, it is possible to prepare soft cheeses of a quality indistinguishable from the cheeses made with animal rennet. *Cheddar* cheese prepared with this material has a good texture and flavour but gave a perceptible bitter taste which could be reduced to some extent by prolonging the period of ripening.

Animal rennet and vegetable enzymes

From the above summary of the literature about milk-clotting enzymes from plant sources, it will be evident that the vegetable kingdom contains some promising materials which could ultimately replace the animal rennet for cheese-making. Some of the most outstanding differences between animal rennet and vegetable enzymes are that the latter have much higher temperature for optimum activity. Within certain limits of temperature, the activity of animal rennet does not show marked change. For instance, though the optimum temperature for animal rennet is round about 50° C., the enzyme is very active even at about 37° C., the temperature commonly used in cheese-making. The activity of vegetable enzymes on the other hand falls off rapidly at low temperatures. Hence a larger quantity of the enzyme is required to be used for cheese-making, since use of higher temperature results in lower yields of cheese. Vegetable enzymes as a rule show much greater response to the presence of added calcium in milk. By adding calcium in such small quantities as 0·1 per cent, the activity of these enzymes is increased nearly three-fold.

Only the enzyme from *Withania coagulans* has been exploited systematically for cheese-making but its drawback in the production of *Cheddar* cheese has already been mentioned. This may be due to the fact that the enzyme has only slight protein-splitting action in contrast to the animal rennet which contains both milk-clotting and protein-hydrolyzing principles. It is therefore likely that a combination of enzymes from *Withania coagulans* or *Ficus carica* with that from *Carica papaya* will give better results. This is an interesting subject which requires further investigation.

INFERTILITY IN CATTLE AND ITS TREATMENT

By M. L. KOHLI

CATTLE which are irregular breeders are a source of great loss to the country. It has been worked out in England that sterility is responsible for about 25 per cent wastage in the dairy herds. Before the war, about 15 per cent of the total cattle population in Germany was being treated for sterility. Similar high figures are available for other countries in which the loss due to sterility has been investigated. In India the exact loss due to it is difficult to determine, but it must obviously be very high. It is generally known that cows in India do not calve every year as in other countries. A cow here will usually drop a calf every two or three years. Cows which are regular breeders may also go barren if the owner overlooks their proper 'heat' periods and fails to get them covered by the bull at the proper time. Besides causing high monetary loss, impaired fertility also upsets the breeding programme. It is, therefore, desirable to take steps to ensure that the cattle breed regularly.

A large percentage of sterile cases, when detected at the proper time, can be cured if the owner devotes some attention to this herd.

Cause of infertility due to bull

Failure of a cow to breed regularly may be due to a defect in either the bull or the cow or both. Ordinarily no attention is paid to the potency of the bull so long as it can mount a cow. A bull may be a very keen and good server, but still it may prove to be infertile. It can usually be suspected when a large number of cows fail to conceive from its services. Infertility may be due to various reasons, but underfeeding and overuse of a young bull and over-feeding and under-use of an old one are probably among the most frequent causes. A sterile bull can be detected by even a layman when it is unable to serve a cow or there is incomplete erection of the male organ. Difficulty however arises when the bull serves normally but fails to settle cows. In somes cases one or both the testicles remain in the abdomen and do not descend into the testicular bag (Scrotum). Such bulls are not dependable breeders as sperms produced at a higher body temperature in the abdomen are not so effective in their fertilizing capacity as those normally produced at a lower temperature in the Scrotum.

Methods of detection: In cases of bulls suspected of sterility an examination of the semen is always advocated. Naked eye examination of the semen sample will help in evaluating its quality. Poor samples are usually watery, whereas good samples are milky or creamy in appearance. Detailed examination of the semen can only be done by careful examination under the microscope. Such an examination of the semen is of great value in the selection of a good breeding bull.

A bull should not be condemned on the examination of the first ejaculate alone. It may be that the first sample obtained is not up to the desired quality. Generally such a sample when obtained after a long interval is defective as spermatozoa stored in the genital tract undergo degenerative changes.

Remedies: Often it is desirable to treat such bulls as are very valuable. Young bulls lacking in sexual desire due to immaturity gain sexual vigour if allowed to run with heifers for a few months. Good feeding and exercise generally help in the development of sexual desire. If the animal feels pain while taking out its penis, it may be due to a wound on the penis or around the opening of the foreskin (Prepuce) and a wash with potassium-permanganate solution (1 : 1,000) for a few days may cure it. Injections of hormones, prepared from the testicular tissues, pregnant woman's urine and pregnant mare serum, etc. which are sold under different proprietory names have often proved effective in cases of lack of sexual desire, undescended testicles and absence of sperms in the seminal fluid. Feeding of Thyroprotein daily in the grain ration for a few weeks may also help in improving fertility and sex urge.

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Infertility due to the cow

Inappropriate time of mating : A cow shows sexual desire when on heat. The common symptoms of heat are thin mucous discharge from the vulva, constant bellowing, frequent micturation, tail held high up and mounting other animals or standing to be mounted. The normal heat period in a cow is generally 24 hours and it usually occurs in a non-pregnant animal after every twenty-one days. At the end of the heat period the egg is shed from the ovary into the female genital tract. Conception takes place only if the sperms meet it within a few hours of its liberation. Early or delayed deposition of sperms will inhibit their union and thus will result in barrenness of the animal. Hence, to obtain high percentage of fertility it is desirable to mate the cow at the end of heat.

Silent heat

All the external symptoms of heat are absent in such animals. Such cases are likely to be overlooked by the owner unless they are let out in the pasture with a bull. Maintaining a bull which has been vesectomized (cord to carry the sperms from the testicles to the exterior is cut) will help in the detection of such animals. A bull of any type can serve the purpose without interfering with the breeding policy as there will be no sperms in the ejaculate.

Short heat

An abnormally short heat period lasting for only a few hours is likely to be overlooked by the owner particularly if it appears at night. During the day time, vesectomized bull may be used for detecting such cases. Letting the animal loose in the herd will also leave little chance of its passing away unnoticed.

Frequency of heat

Heat period is controlled by the interior lobe of Pituitary, a small gland located at the base of the brain, through the secretion of two substances (hormones) in the body system. One matures the egg-sack (follicle stimulating hormone) and the other helps in its rupture (luteinizing hormone) to liberate the egg for fertilization.

When the proper balance between these substances is disturbed, the animal is likely to suffer from some disorder of the ovary with its specific symptoms. Cysts may develop if there is an excess of the secretion of follicle stimulating hormones, when the ripe egg follicle on the surface of the ovary goes on enlarging but does not rupture. When a large cyst so forms, heat does not occur and the animal's vulva swells, the root of the tail rises and may show hollows on each side of it. In the early stages, these cases can be cured by rupturing the cyst per rectum with the pressure of the finger. In long-standing cases, cysts should be punctured with a needle inserted through the vaginal wall by an expert. The operation is to be repeated after a week if the cyst has re-formed. Generally, normal heat followed by ovulation appears in three weeks' time from the date of second rupture.

Some cases show symptoms of heat every few days (Nymphomania) when follicles turn into small cysts, one for each time the animal comes on heat. These cases are cured when the cyst is ruptured per rectum. Pergnant woman's urine is also useful in curing such cases. The animal becomes quiet in 24 to 48 hours.

Long heat-cycle in cows

If the secretion of luteinizing hormone in the body system is in excess, the yellow solid spherical growth (corpusaluteum) on the surface of the ovary does not regress and the animal does not come on heat. It can be cured by a trained hand when the corpusaluteum is squeezed out by exerting the digital pressure per rectum between the 8th and 12th day after the heat. The cow generally comes on heat within 2 to 6 days.

Late-maturing heifers

A large number of heifers do not come on heat till about four years of age. Besides mal-nutrition, the hormonal deficiency in the system is also responsible for it. The ovaries in such cases fail to ripen the follicle. Such cases, when diagnosed by rectal palpation, can be cured with injections of pregnant mare serum in proper doses. Heat is induced within a week following the treatment. The hormone will also be found effective in cases of cows with a long inter-calving period. This condition is often due to a failure of the ovaries to function properly for a long time after calving.

Diseases of the female genital tract

The sperms have to travel a long way up in the genital tract of the female before they can meet and fertilize the egg. Although one sperm is required to fertilize the ovum, yet a sufficient number must reach the tube connecting the ovary with the womb (fallopian tube) to liberate the egg from its outer layer. This is brought about by the liquefying section of ferments (enzyme) secreted by the sperms. Hence to facilitate the travel of the sperm, the female passage should be smooth and normal. Any abnormality in the quantity and/or quality of the uterine secretion or obstruction due to inflammation at any portion in the female tract will kill the spermatozoa or impair their fertility. Thus the incidence of fertilization will be reduced. Equally bad results will be obtained if the ovaries responsible for producing the ova are diseased. Cases of this type can be detected by examining the organs per rectum.

Due to infections in the genital tract there may be discharge, often offensive in odour, from the vulva. In such cases, douching daily with any of the following solutions would give beneficial results:

1. Permanganate of potash (1—1,000)
2. Cresol or carbolic acid (three tablespoonful to one gallon of water)
3. Perchloride of mercury (1—10,000)

Care should be taken that no solution remains in the womb, as it will putrefy in it and aggravate the trouble. Some of it will be expelled by the animal and the rest should be removed by pressure of the hand exerted per rectum.

Dietetic errors

Sterility may result from mal-nutrition when the general condition of the animal is poor, or it may result from over-feeding and lack of exercise with consequent obesity. Plenty of exercise with high protein feed and supply of green fodder, sprouted oats or wheat germ oil, help in restoring the condition.

F. A. O. CENTRE IN DELHI

THE Food and Agricultural Organization of the United Nations has, as part of the development of regional activities, established a Regional Information Centre in New Delhi. It will be responsible for dissemination of useful information, resulting from or contributing to the work of the organization, in a group of countries in South and East Asia, including India, Burma, Celyon, Indonesia and Malaya.—*Food Bulletin*, November 8, 1948.

THE SNAKE GOURD IN SOUTH INDIA

By A. SANKARAM

AMONG cultivated gourds in South India, Snake gourd easily occupies the pride of place as the most wholesome and nutritious vegetable. The Snake gourd is a native of China and in that country the young tender fruits are frequently used as food. It hails from the Cucurbitaceous family and comes under the genus Tricosanthus. This genus embraces two distinct species of economic importance, *Tricosanthus anguina* L., the common gourd of South India and *Tricosanthus dioica* Roxb., the popular gourd of Northern India, Bengal and Baroda. Both are annual herbs or shrubs climbing by means of tendrils, the former bearing large slender fruits of 4 to 5 ft. length and the latter producing oblong fruits 2 to 3 in. long and globular in shape. The latter is practically unknown in Madras except in taluks of North Vizagapatam bordering Orissa. A short account of the culture of the common Snake gourd (*Tricosanthus anguina* L.) of South India, is given below.

Cultivation procedure

Soils: This vegetable crop is raised over a wide range of soils but for commercial production of the crop, fertility and drainage conditions are given preference to land choice. Successful crops are seen on light to heavy loams of medium fertility allowing free drainage. Sandy soils supplemented by bulky organic manures can be utilized for crop production. Land choice, at present, is scarcely a pre-condition, as instances of largescale production of the vegetable are only sporadic. The land is ploughed twice to remove the stubble of the previous crop and weeds. Small pits are then dug out at 8 to 10 ft. apart either way. In back-yard cultivation, ploughing of the land is not resorted to but only pits are dug out at the said spacing.

Manures: The crop responds to good manuring but excess of the same results in large vegetative growth at the expense of fruit development. The pits are manured with well-rotten farmyard manure and ashes, each pit receiving 25 lb. of farmyard manure and 5 lb. of ashes. The manure is applied in one block dose a week in advance of the sowing of the seed.

Seeds and sowing: Seed for sowing is gathered from good-sized fruits specially set apart for the purpose. When the fruits assume bright pink colour and begin to burst the seeds are removed from the pulp, washed and dried. Such seeds are embedded in cow-dung, dried in the sun and stored in mud pots. Seed preserved in this manner is known to be viable for more than a couple of years. Three to five seeds are sown in each pit and 3 lb. of the seed sow an acre. Some 1,300 to 1,400 seeds make a pound.

Irrigation: As the crop is mostly raised in back-yards and on a very limited scale by the farmers, pot watering of the crop is usually resorted to, as and when the crop needs it.

After-care: Being weak-stemmed, the young plants with tendrils are first trailed on to bushy supports such as old *arhar* stalks or any other material suitable for the purpose. The tendrils are finally carried on for a horizontal spread over an elevated structure (*machan*) of nine feet height from the ground. It is not uncommon to find fruits coiling and such ones, if neglected, neither grow well nor find a sale. When coiling is noticed in early stages, a small stone is tied to the free end of the fruit by a thread which induces normal straight development of the fruit.

Yield

The crop is quick-growing and in 36 days from the date of sowing it begins to flower, and in another three weeks tender fruits are ready for harvest. The period of harvest lasts for nearly five weeks. When grown under ideal conditions which are fertile loamy soil, adequate manuring and irrigation, it gives a bumper crop and the fruit yield often

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surpasses anticipation. Over a cent of land an yield of 100 fruits each weighing 5 lb. is considered normal and still higher yields are not uncommon.

Pests

The Snake gourd semi-looper (*Pulsia peponis* F.) is practically the only pest known to cause considerable damage to the crop. The caterpillars of the pest are found in the folds of the leaves. They voraciously feed on the leaves and the young vines often suffer badly. The damage can be minimized if the affected leaves are regularly removed and burnt. This pest is more or less confined to this vegetable crop and is rarely seen on other cucurbits.

Economics

It is difficult to compute costs of production on an acre scale as it is not raised to that extent. On account of the perishable nature of the crop and difficulties of its transport over long distances, over-production is feared to be uneconomical. When grown over small plots and in the back-yards the cash expenditure is insignificant. On an average it would cost Rs. 25 to raise a crop of this vegetable over a plot of eight cents. An yield of 1,200 fruits from the plot would fetch Rs. 42 at the rate of Rs. 3-8 per 100 fruits. A net gain of Rs. 17 can thus be expected.

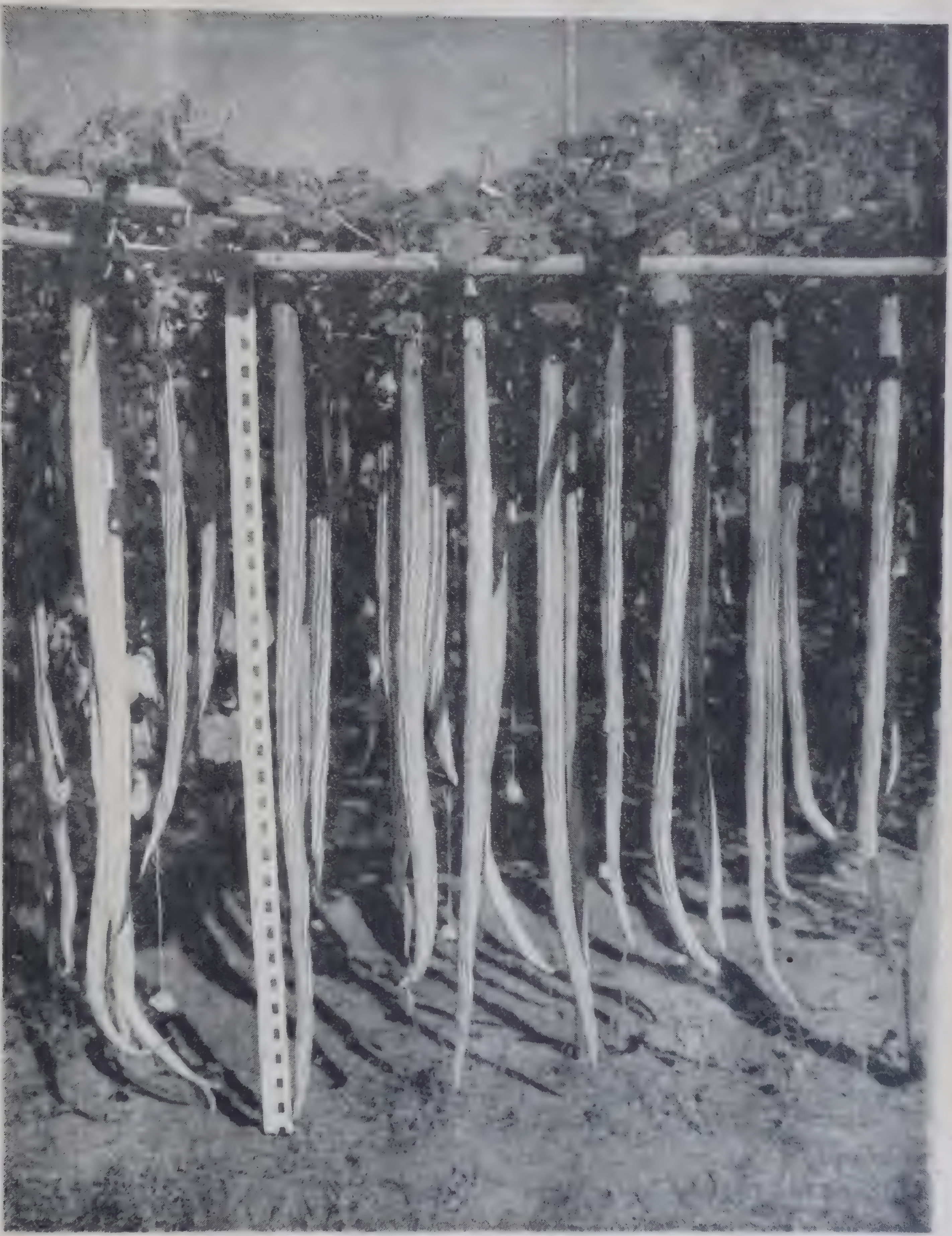
Suitability for kitchen garden

As a quick-growing but heavy yielding vegetable crop the Snake gourd has few equals. The ease in its cultivation over a wide range of situations is an added advantage. The Snake gourd claims a rightful place in the kitchen garden because its culture combines the profits of a money crop with the advantage of being a delectable and nutritious vegetable agreeable to all ranks of society.

USE OF NITROGEN AS FERTILIZER

CANADIAN consumption of nitrogen fertilizer has increased from some 11,000 tons in 1940 to about 27,000 tons in 1947. On a population and crop acreage basis Canada still uses relatively little nitrogen as compared with some countries. About 90 per cent of it is used as an ingredient of mixed fertilizers and five per cent for side dressing, mainly for leafy vegetable crops. The estimated tonnage of nitrogen for fertilizer materials for all fertilizer purposes used in the trade year ended July 1, 1948, was 127,318 tons.

With the exception of 40,250 tons of ammonium phosphate, about 90 per cent of the total was used in the five Eastern provinces and ten per cent in the Western provinces of Manitoba, Saskatchewan, Alberta and British Columbia. Some 36,000 tons were used in the Prairie Provinces mainly for growing sugar beets and grain—principally registered and certified seed grain. The demand for 11-48 ammonium phosphate in the Prairie has increased rapidly and there is still a shortage of this fertilizer for that part of Canada, as well as drill attachments for applying it.—*Farm News*, September 1, 1948.



Snake gourds under a bamboo pandal.

TUBERCULOSIS AND JOHNE'S DISEASE IN CATTLE

A SCHEME for dealing with the investigation on tuberculosis and Johne's disease is being run by the Indian Council of Agricultural Research at Indian Veterinary Research Institute with a view to find out the incidence of the diseases in this country and the methods of control. As a result of the work carried out under the scheme the incidence of tuberculosis in some parts of the country has been determined. This shows that our cattle are not free from tuberculosis, which was the general impression with the lay public some time back. The method of diagnosis which has been used for the last several years in other countries, has been tried with success and the manufacture of diagnostic agent, tuberculin, has been taken up at the Central Veterinary Institute.

It has been shown that the disease is common around large towns and cities where an approach to intensive dairying is made. Municipal bullocks in many cities, e.g. Madras, Puri (Orissa), are badly infected. Investigations so far completed tend to show that this disease in domesticated animals in India has not the same danger for human beings as it had in the West, for instance; in none of the human cases of tuberculosis studied has the bovine organism been found to be responsible, nor has any milk been found to be infected, although all of the 72 samples tested in the Punjab came from infected cows. The habit of boiling of milk before consumption lessens the risk. Only the direct method of infection between cattle and man, a method which up to now has been depreciated and which is now proving to be more serious than what was realized, would appear to be of importance to India. If practical methods for control and eradication of tuberculosis are evolved, it is possible to cut down losses, particularly, in the dairy herds. One instance deserving mention where the elimination of this disease from a herd has been brought about through hygienic measures, was at Hissar Farm. If these herds are kept free from tuberculosis, the saving would amount to several lakhs of rupees in the country as a whole. (H.K.L.)

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. (1) We have to experience serious difficulties due to non-availability of sufficient bullock-rations. There are of course plenty of sweet potatoes in this part of the country. Could you kindly let me know the value of sweet potatoes as feed for bullocks so that we may include the same in the ration for the animals? (S. R. V.)

(2) Will you please let me know if the feeding of plantain leaves and trunks is in any way injurious to the cattle? (M. A. K.)

A. (1) There is no harm in feeding sweet potatoes to bullocks. Sweet potatoes are deficient in calcium and phosporus but rich in starch. The deficiency of calcium and phosporus in potatoes is made up by feeding bone-meal to the animals. Grain part of the ration should consist of high quality protein. The potatoes should be chopped up before feeding. The animals should be gradually accustomed to sweet potatoes. In any case the quantity of sweet potatoes should not exceed half the total ration of the animals. (I.C.A.R.)

(2) No work has been done on the feeding of plantain leaves and trunks to animals in this country. As such no information on the subject is available. Stray cattle haunting city streets generally pick up bits of plantain leaves without any visible effects. It is not customary, however, to feed plantain leaves and trunks to the cattle. (I.C.A.R.)

CROP INSURANCE IN INDIA

IN the light of the experience gained by other countries in crop insurance, India is considering undertaking experimental crop insurance schemes under the aegis of the Central Ministry of Agriculture. Because of India's complete dependence for good crops on adequate and timely rainfall, India is vitally interested in schemes devised for protecting the cultivator against failure of crops. Mr. G. S. Priolkar, who has been appointed to study the problems involved and prepare experimental schemes to operate in selected areas is shortly undertaking a tour of the provinces.—*Food Bulletin*, October 18, 1948.

ASSAM

N. K. DAS

THE second meeting of the Assam Food Advisory Council was held at Tezpur on 17 and 18 May, 1948, with the Hon'ble Shri Omeo Kumar Das, Minister for Food, in the chair. The more important recommendations made by the Council at this meeting are mentioned below. These include some of the recommendations originally made by the Sub-Committees appointed by the Council at their first meeting and approved by them at this meeting.

Mechanization of agriculture

It was recommended that 'An area of 10,000 acres of sparsely occupied land in some undeveloped area should be declared a State Farm. The Government will organize the main large fields for mechanized cultivation to the extent of 50 per cent, i.e. 5,000 acres, the labour for which will be drawn from small holders' families. These small holders or cultivators would occupy the areas of *hollas** for rice and marginal lands round the large unbroken fields as their own holdings. They would be paid for labour given to the State Farm at first and gradually would be led into a system of collective sharing in the State Farm'.

This recommendation was made with the suggestion that 'a special officer and staff should be appointed immediately to prepare the scheme in detail'. It may be noted that although this recommendation has been made in connection with the mechanization of agriculture, it will, if given effect to, incidentally bring a large area of hitherto undeveloped land under cultivation.

There were other recommendations in regard to tractor pools, a scheme for which has already been sanctioned by the Government.

Improvement of statistics

The Council made a number of recommendations on this subject. Some of these are enumerated below.

1. Action to obtain 'accurate and adequate statistics relating to the different aspects of the economic life of the people' be given high priority by the Government.
2. A section of the newly-created Department of Economics and Statistics 'should immediately take over the duty of compiling agricultural and food statistics, employing the present machinery for the collection of primary data'.
3. The Government be pleased to take necessary action for the modification of existing rules of procedure in order to enable the new Department to take over this duty.
4. The question of improving the primary statistics be examined by the new Department in consultation with the other Departments concerned.
5. 'The Government be pleased to take steps for strengthening' the existing machinery for the collection of primary data.
6. The question of bringing out a monthly agricultural journal in Assamese which would contain 'popular articles on crop statistics as one of its regular features' be examined by the Government.
7. With a view to taking suitable action, the Director of the newly-created Department of Economics and Statistics be asked by the Government 'to advise them on measures to be adopted for obtaining and compiling accurate and adequate statistics in regard to all vital aspects of the general economic life of the people of Assam'.
8. The Government be pleased 'to sanction such expenditure as may be found indispensable to complete' the multi-purpose village survey proposed by the Director of the Department of Economics and Statistics.

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*Low-lying areas.

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9 (a) 'One of the ultimate objectives of the Department of Economics and Statistics' should be to bring the Assam States 'within the field of its operations, as these together with the province of Assam may be considered as one economic unit'.

(b) 'Suitable steps should be taken to get accurate and adequate statistics from permanently settled areas as well'.

Incidentally it may be mentioned here that an elaborate questionnaire has already been prepared by Dr M. N. Goswami, Director of Statistics and Economic Adviser to the Government of Assam, for the proposed multi-purpose village survey and approved by the Government.

Village and sub-divisional production committees

It has been recommended that a village production committee consisting of not less than 7 and not more than 12 elected members and the highest local agricultural officer, be organized in each *mauza* or *thana* in the plains districts of Assam. The duties of the committees will be to collect facts and figures in regard to their respective areas which will enable proper decisions to be taken for the extension of cultivation and other matters relating to food production. They will also be responsible for the efficient performance of work set out for their respective centres.

It is also recommended that there should be sub-divisional committees to 'guide, supervise, and coordinate the activities of the village production committees, implement the policies laid down by the Government and the Food Advisory Council, maintain close contact with the public and the Department of Agriculture and submit reports to the Government and publish bulletins for local consumption'. A sub-divisional committee, according to the recommendation of the Council, will consist of the Sub-divisional Officer or the Deputy Commissioner (who will be the Chairman of the Committee), the Chairman of the Local Board, two local officers of the Department of Agriculture (ex-officio) and two members nominated by the Government.

Land utilization

The Council made a very important recommendation on this subject, which, if implemented, is expected to give valuable information to the Government. The following is the full text of the recommendation :

'The Council strongly recommends that a separate Bureau be constituted for the collection of all information relative to the land and land utilization in the province.

'It should be emphasized that the work of the Bureau should be limited to the collection, sorting out and putting into available form all the information required to enable the Government to come to a sound decision on all matters relative to land utilization.

'It is suggested that the Bureau be a small coordinating body with sectional links with all Departments and that its functions should be as follows :

A. Availability of land

1. Reconnaissance from maps, records, aerial photographs.
2. Rough investigation from ground of selected areas.
3. More detailed investigation of particular portions of selected areas required for immediate settlement.
4. Gradual extension of detailed survey to cover all areas.

B. Utilization of land

1. Land usable without any special preparation for staple crops.
2. Land which may be rendered usable by small-scale efforts such as may be carried out by villagers or other local bodies.
3. Land requiring major operations as a preliminary to utilization.
4. Land definitely unusable for field cropping.

C. Coordination of methods for improving conditions in existing cultivated areas and their vicinity

1. Controlled irrigation by silt-laden water.
2. Improvement in drainage, etc'.

MADRAS

K. P. DORAISWAMI

THE Hon'ble Sri Jairamdas Doulatram, Minister for Food and Agriculture, observed while opening the All-India Cattle Show in New Delhi on 29 January 1948: 'The cattle problem in India is not merely a humanitarian problem of animal welfare but that in it are substantially involved both the health and the wealth of the Nation'. That Madras is not slow or tardy in realizing the true significance of this statement can be seen from the way she has been tackling her livestock improvement problem, though she is now in the thick of an all-out fight to keep away food famine. Good progress is being made in the various schemes for livestock improvement, and there is noticeable great enthusiasm all over the province among livestock owners, big and small.

Cattle shows

During the year 1946-47 three All-India Regional Cattle Shows were held successfully at Ongole, Tiruppur and Valparai under the auspices of the All-India Cattle Show Committee. In addition to these, sixty 'One-day Cattle Shows' were held during the year in the 24 districts of the province under the auspices of the Animal Husbandry Department. These 'One-day Cattle Shows' are becoming more and more popular and are proving to be of great educative value to cattle-owners—especially the poorer ones. Though it is too early to expect tangible or immediate results, it cannot be gainsaid that these shows have aroused the interest of the ryots in scientific stock-rearing. This interest, if it is kept up by the holding of more and better shows every year, and also by the help and advice given by the Animal Husbandry Department, is bound to be of immense aid to the breeding programme in this province.

One notable feature of these shows is that some of them are now being held under the aegis of the *Firka* Development Scheme now sponsored by the Government of Madras. Under this Scheme, one *firka* in each district has been selected by the Government and intensive rural reconstruction activities of the various Departments are concentrated here. The keynote of this Scheme is self-help. From this point of view, it is encouraging to note that the willing cooperation and keen enthusiasm of the villagers contributed to a great extent towards the success of many of the cattle shows.

During the year 1947-48, six 'One-day Cattle Shows' have so far been held in East Godavari District at Ramachandrapuram, Amalapur, Tuni, Rajahmundry, Kirlampudi and Cocanada. A sum of Rs. 2,923 in all was distributed as prizes in these shows. In Trichinopoly District three 'One-day Cattle Shows' were held at Lalgudi, Turaiyur and Perambalur, and a sum of Rs. 1,020 was distributed as prizes. Several such 'One-day Cattle Shows' were also held in all the other districts of the province, including Negapatam in Tanjore District, Irulla and Rallabuduguru of Chittoor District, and Shermadevi of Tinnevelly District. In all these shows, the standard of animals exhibited was of a high order.

Gaushalas

There are 35 *gaushalas* and *pinjrapoles* in this province, having under their care nearly 1,500 heads of cattle. Of these, the largest and the best managed is the *pinjrapole* at Madras City, which maintains more than 300 animals. This Institution was started as early as 1906 under the auspices of Sir Arthur Lawley, the then Governor of Madras, and with a large initial donation from Her Highness the late Maharajkumari Saheba of Vizianagaram. The Madras *pinjrapole* has had a succession of distinguished Chairmen including Judges of the High Court. It has been serving well the cause of the derelict and disabled animals these forty years and more. It is gratifying to note that the institution has been carrying on its humanitarian work all these years with the private donations and contributions made chiefly by the Gujarathis,

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Marwaris, Nattukottai Chettiars and others. In addition to cash donations, philanthropic ladies and gentlemen have contributed towards the construction of cow sheds and other buildings inside the *pinjrapole*. On an average about Rs. 40,000 are spent annually for the maintenance of cattle and on other heads. About half this amount is met by way of public donations and the other half is realized by the sale of milk, manure, cow-dung cakes, etc. and from interest on capital investment which amounts to nearly 1½ lakhs of rupees.

One important feature observed in recent years in the working of the Madras *pinjrapole* is the practice of maintaining a number of good milch cows to augment the resources of the institution. This is a healthy procedure and should be resorted to more and more till the institution becomes self-supporting.

SCIENCE AND FOOD

IN recognition of the good work done by the Australian Council for Scientific and Industrial Research and the Waite Institute of South Australia, the British Commonwealth specialist conference on climate and animal nutrition will be held in Adelaide, South Australia, next year.

Scientists from the C.S.I.R. and Waite Institute have collaborated in investigations which have led to discoveries of tremendous significance. They have found that vast areas of the earth's soil may not be of low fertility but possibly need only minute traces of certain elements, mainly copper, cobalt, manganese, molybdenum and zinc, to produce vigorous and healthy growth.

Following overseas experiments which showed that the absence of traces of copper and zinc from some classes of soils retarded plant growth, the Australian scientists found that the cause of 'Grey-speck' disease in crops of oats in certain South Australian districts was absence of manganese in the soil. Addition of a few pounds of this element to the superphosphate used in cultivation resulted in good oat crops. 'Coast sickness' which made it impossible to graze sheep for any time on the calcareous soils of coastal area of South Australia was traced to the absence of minute quantities of cobalt and copper. When these deficiencies were made good by top-dressing or the use of salt licks including copper and cobalt, the sheep remained perfectly healthy. Later came the discovery that small quantities of molybdenum applied to the soil gave a phenomenal pasture growth, while in commercial forestry it was found that the application of a little zinc caused stunted patches of pinus radiata to grow vigorously.—*Agricultural Newsletter*, No. AGN/216.

DEVELOPMENT OF ARTIFICIAL INSEMINATION IN THE NETHERLANDS*

By Th. STEGENGA

SINCE 1930 artificial insemination has been applied in the Netherlands by a few veterinary surgeons in a small number of cases, partly by way of experiments, partly in cases where the animals failed to conceive in natural service. In 1943 certain groups of stockmen took to artificial insemination on a cooperative basis. For this purpose a few laymen were trained by a veterinary surgeon. These societies, which were six in number, each comprised some 400 cows and one bull. Artificial insemination was applied among other districts in such parts of the country as showed a serious decline in fertility of the cows. The main purpose, however, has always been the improvement of the breeds. These societies were all set up in regions where small holdings predominated.

Already during the German occupation artificial insemination was made subject to certain conditions. Licences for the application of artificial insemination were issued in those days by the Livestock Division of the Department of Agriculture. When the country was liberated in May 1945 these restrictions were lifted automatically.

In May 1946 artificial insemination was once again put under a restraint by the Government. Licences are now only issued by the Department of Agriculture if certain conditions are observed. These include the following: (1) Artificial insemination shall only be applied by breeding associations, which implies that private persons are not allowed to sell semen of a bull; (2) the bulls shall meet certain requirements, both with regard to conformation and production, the latter being regulated provincially; (3) the artificial insemination proper shall be directed or supervised by a veterinary surgeon; (4) the lay-man who shall be charged with the execution, shall be trained to it beforehand; and (5) the animals inseminated shall together with the progeny be properly registered. Veterinary surgeons may freely apply artificial insemination.

In 1946 approximately 35 associations, comprising some 17,000 animals, used artificial insemination. Most of them worked with about 500 animals, 1 bull and one inseminator. Particularly in the east of the Netherlands this way of inseminating is being applied on quite a large scale. The main reason for this extensive application lies in the fact that in regions a widespread infertility of the cattle has become apparent. The ultimate object of artificial insemination in this part of the country is to come to an efficient and reliable method of herd improvement, which should also be within the reach of the small holder. The results obtained in the year 1946 greatly differ from each other. So far as the ten societies set up in the northern provinces of Friesland and Groningen are concerned, the percentage of cows which conceived after only one insemination ranged from 50 to 75, the general average being 90 per cent.

In the western part of the country more than 20 breeding associations applied artificial insemination. On account of a widespread infertility of the cattle in these parts the method was applied rather rashly. Expert supervision had not been provided for. In many cases the results fell far short of the expectations. The cows of only a few societies readily conceived. The principal mistakes made were:

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1. Bulls that were contaminated with diseases of varying description, including sterility, were used.
2. The bulls were caused to serve for too often, which led to the production of inferior semen.
3. Expert supervision was not available. At the end of the year when attention had been directed to these blunders, the results were a bit better.

In the Netherlands laymen apply artificial insemination. They collect the semen, inseminate the cows and record the various data. Diluting the sperm is likewise most times done by the inseminator, under the supervision of a veterinary surgeon.

The general direction of artificial inseminations rests with veterinarians. Rather serious difficulties are experienced in this connection in the Netherlands, as there is a great shortage of veterinary surgeons, which is closely bound up with the fact that the Universities were closed during the last two years of the German occupation.

The speculum method is used in this country. Its advantages are :

1. The inseminator sees when an animal is in heat.
2. The inseminator sees whether there are any deviations in vagina or cervix. Should there be any, he is not allowed to inseminate, but he has to call in the veterinary surgeon. The latter examines the cow, and if necessary, puts her under his treatment.
3. The rectal method is not generally applied.

Various designs of specula are used in inseminating cows artificially. The semen is introduced by means of either a syringe which is guided into the cow through the speculum, or a glass pipette, which, by means of a rubber balloon or glass syringe, can be filled and emptied. Most times diluted semen is used in the Netherlands. The common diluting agent is phosphate of yolk, but citrate of yolk is also used sometimes. Gelatinized semen is only used by a few artificial breeding associations. The semen is always introduced into the cervix, not into the uterus. Elaborate researches are being made at the Veterinary University at Utrecht into both the artificial insemination and the quality of the semen.

U. S. FIRM DEVELOPS NEW FIBRE

A NEW synthetic fibre, called 'orlon', has been developed by the American firm, E. I. du Pont de Nemours & Co.

Just as nylon and rayon, the new fibre is derived from so-called acrylic and vinyl resin compounds but possesses distinct chemical properties, said to fill the gap both in price and performance between nylon and rayon.

One of orlon's important characterisitics is its resistance to sunlight, that makes it suitable for automobile tops, awnings, sails, and other outdoor articles. It is not easily damaged by chemicals, is resistant to insects, and does not deteriorate at high temperature. An orlon plant to be erected in the State of South Carolina is scheduled to reach full-scale output within two years.—(*U.S.I.S.*)

Home Gleanings

POSSIBILITIES OF INCREASED PRODUCTION OF JUTE IN THE INDIAN UNION

By B. C. KUNDU

WITH the division of India into two independent States and the partitioning of Bengal into East and West Bengal, the jute industry is faced with a very serious problem. The Indian Union produces only 20 per cent of the combined output of Indian Union and Pakistan, which is very much less than what is required to meet her own demand. If she does not increase her production of jute, India will have to depend annually on Pakistan for about 43 lakhs of bales (each bale weighing 400 lb.) to meet the requirements of her mills and domestic non-mill consumption. The Pakistan Government has already imposed a heavy duty on the export of raw jute beyond her borders; as a result the cost of Pakistan jute in India will be considerably increased. Besides, the supply of raw jute to India may be altogether stopped by the Pakistan Government. Therefore, with the object of achieving national economic self-sufficiency and of becoming free from the dangers of emergency, India should produce enough jute to meet her own requirements.

It has been discussed in this short note as to how jute production can be increased without decreasing the acreage under rice or other cereals used as foodstuff. It will be seen that if sufficient quantity of seeds of improved strains are produced and distributed properly, if necessary arrangements are made for the supply of fertilizers to the cultivators and if a small portion of the vast tracts of culturable wastes and current fallows are reclaimed for the cultivation of jute, Indian Union will be in a position to produce enough jute to meet her requirements. Arrangements for bringing the waste lands under irrigation will further facilitate the production of more jute along with more food. It may be possible to increase jute acreage to some extent by practising the system of double cropping in suitable *aman* paddy lands of the Indian Union, where it is not now followed. It is also possible to extend jute-cultivation in other provinces besides the four jute-growing provinces, viz. West Bengal, Bihar, Assam and Orissa.

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Need of Indian Union

The aim of the Indian Union would at present be to produce enough jute for domestic non-mill consumption and feeding all the mills. The question of export of raw jute has, at present, been left out as it is expected that the major portion of raw jute demanded by foreign countries will be met by Pakistan, where there are at present no jute mills.

Consumption of jute in India

	Lakhs of bales
Pre-war (1934-35 to 1938-39)	
Average annual mill consumption ...	55·5
Average annual mill exports ...	42·1
War period (1939-40 to 1945-46)	
Average annual mill consumption ...	63·1
Average annual exports	16·6
(1946-47)	
Mill consumption	56·3
Exports	15·0
Domestic (non-mill) consumption ...	6·0

It will be seen that since the outbreak of World War II Indian mill consumption has gone up and exports have relatively declined. It has been found that the domestic non-mill consumption is very little (about 6 lakhs of bales per year). The present need for the Indian Union may be roughly estimated on the basis of pre-war figure at about 60 lakhs of bales per year: mill consumption—55 lakhs of bales, and domestic non-mill consumption—5 lakhs of bales.

Present position : In 1946 the area under jute in the Indian Union was 0·539 million acres. In 1947 there has been a slight increase in acreage. From the final forecast figures of this year (1947-48) the total output of jute in the Indian Dominion is estimated to be 17 lakhs bales as against 68·4 lakhs bales in Pakistan (East Bengal), that is, the total output in India is roughly about 25 per cent of the output in Pakistan and about 20 per cent of the combined output of India and Pakistan. (The acreage and output for 1946-47 and 1947-48 have been shown in Table I). It will be evident from this that India will have to produce 43 lakhs of more bales to meet her own requirements. It is to be considered if that is possible. When this can be achieved production may be further increased to meet the requirements of raw jute export trade.

Possibilities of increased production

The output of jute can be increased, (i) by increasing the yield per acre by the use of seeds of improved strains and by the application of correct fertilizers, and (ii) by increasing the acreage.

(I) INCREASE IN YIELD PER ACRE

Application of fertilizers : In 1946 and 1947 the yield per acre in the Indian Union was 2·4 and 2·6 bales respectively compared to 3·0 and 3·3 bales respectively in the Pakistan areas (Table I). The low yield in the former is mainly due to the poorer type of soil. It would be possible to reduce the deficiency of the soil by judicious application of fertilizers. It is known that lime and potash produce considerably increased yields of jute on the old alluvium. It has recently been established by the Jute Agricultural Research Laboratories that by proper manuring with optimum doses of nitrogen and potash the yield of the fibre will be considerably increased and the incidence of disease will be much lower (*Annual Report*, Jute Agricultural Research Laboratories, 1945-46, 1946-47).

The results of the experiments in 1945-46 and in 1946-47 are given in the following Tables. (N_1=Ammonium sulphate @ 1·8 maunds per acre, K_1 Muriate of potash @ 0·6 per maund acre. 1=single dose, 2=double dose, and 3=treble dose). The fertilizers were applied after a basal dressing of 100 maunds of F.Y.M. (Farmyard Manure) per acre.

EXPERIMENTS IN 1945-46

Manurial trials

D.154			Chinsurah Green		
Treatment	Yield per acre in md.	Per cent on control	Treatment	Yield per acre in md.	Per cent on control
N_3K_3	23·9	314·5	N_3K_2	21·7	278·2
N_3K_2	22·9	301·3	N_3K_1	21·1	270·5
N_3K_1	18·1	238·2	N_2K_1	19·9	255·1
N_2K_3	16·3	214·5	N_3	19·6	251·3
N_2K_1	15·3	201·3	N_3K_3	19·6	251·3
N_3	14·9	196·1	N_2K_3	19·2	246·2
N_2	13·9	182·9	N_1	16·7	214·1
N_2K_2	13·5	176·3	N_2	15·8	202·6
N_1K_2	12·0	157·9	N_2K_2	15·5	198·7
N_1	10·3	135·5	N_1K_2	15·2	194·9
N_1K_1	10·2	134·2	N_1K_3	15·0	192·3
N_1K_3	9·3	122·4	N_1K_1	14·2	182·1
K_3	9·0	118·4	K_1	13·8	176·9
K_2	8·8	115·8	K_2	10·1	129·5
F.Y.M. (Control)	7·6	100·0	K_3	10·0	128·2
K_1	7·1	93·4	F.Y.M. (Control)	7·8	100·0

EXPERIMENTS IN 1946-47

Manurial trials

	D.154			Chinsurah Green		
Sl. No.	Treatment	Yield per acre in md.	Per cent on control	Treatment	Yield per acre in md.	Per cent on control
1	N_2K_2	18·65	286·9	N_3K_2	19·65	633·8
2	N_3K_2	17·44	268·3	N_1K_2	15·03	484·8
3	N_3K_1	16·23	249·6	N_3K_3	14·86	479·3
4	N_3K_3	14·97	230·3	N_3K_1	14·66	472·9
5	N_2K_1	14·43	222·0	N_2K_3	14·47	466·7
6	N_2K_3	13·43	206·6	N_2K_1	13·51	435·8
7	N_3	12·53	192·7	N_3	13·46	434·1
8	N_1K_2	11·04	169·8	N_1K_1	12·05	388·7
9	N_1K_1	10·15	156·1	N_1K_3	11·10	358·0
10	N_1	9·19	141·3	N_2	10·47	337·7
11	N_2	8·86	136·2	N_2K_2	9·17	295·8
12	N_1K_3	3·25	111·5	N_1	8·36	269·6
13	F.Y.M (Control)	5·49	100·0	K_2	6·38	205·8
				K_3	5·49	177·0
14	K_2	6·26	96·3	K_1	4·53	146·1
15	K_3	5·63	86·6	F.Y M. (Control)	3·07	100·0
16	K_1	5·36	82·4			

Seeds of improved strains: There are two improved strains of jute, D154 (*Capsularis*) and Chinsurah Green (*Olitorius*) which usually give on an average 20 to 30 per cent higher yield than the locals, but on account of the high price and lack of suitable arrangements for the multiplication and distribution of seeds these varieties cannot usually be grown by the cultivators. These strains will have to be cultivated on an effective scale. Besides the existing improved strains, the Jute Agricultural Research Laboratories have already evolved some high yielding types, which have been found to be superior to the departmental strains. They have also been trying to evolve some very improved strains in which the increase is expected to be up to 100 per cent.

The total jute-producing area in undivided India in 1946 was 1·9 million acres. There is no reliable information as to how much of this area was under improved strains. It is ascertained that only a small quantity of seed to sow only 3,000 acres was sold by the Government Jute Seed Agent, Bengal, during the year. Even assuming that the cultivators grew some seeds of improved strain it may still be said that a very small area was under improved strains and the supply of improved seeds was much too inadequate for the area under jute.

By the use of improved strains it will immediately be possible to raise the average yield of jute in India by at least 20 per cent. If fertilizers were used, we could have reasonably expected a 50 per cent increase in the yield of fibres, that is, from 2·4 bales per acre to 3·6 bales per acre in 1947. The output in 1947 would have, therefore, been about 25 lakhs of bales instead of 17 lakhs of bales. Even if we assume that a portion of the areas sown in 1947 was under improved strains, we could have reasonably expected at least 22·6 lakhs of bales at the rate of 3·5 bales per acre on the average.

But even then we would have to produce 37·4 lakhs of bales more to meet our demand and for this some increase in acreage has to be made.

(II) INCREASE IN ACREAGE

In 1940, the last year of unrestricted jute cultivation in Bengal, the area under jute in the Indian Union was 1·26 million acres. This aggregate was the sum total of the maximum areas for all jute-growing areas of the Union except Bihar which had the highest acreage for jute in 1936. If we replace the actual area for Bihar in 1940 by its maximum value in 1936 we get a computed maximum of 1·44 million acres of jute land in the Indian Union. The additional jute-tried area comprising about 0·8 million acres (area in 1947 being 0·645 acres), which forms an insignificant portion of the total land under cultivation in the Indian Union, may be immediately brought under jute cultivation. By producing jute at the rate of 3·9 bales per acre it will immediately be possible to produce 31 lakhs of bales.

But most of the 0·8 million acres of land is now under food crops. On account of the acute food shortage in the country, increase in jute acreage at the expense of food crops may perhaps be objected to.

Increase in jute acreage can be effected by (a) utilizing small portion of cultivable waste lands and current fallows lying in the jute-growing areas, (b) extending jute cultivation in other provinces and States, (c) practising a system of double cropping, i.e. growing jute before *aman* paddy in the suitable areas and (d) providing irrigation facilities in certain areas which have proper soil and other conditions but have not the rainfall at the proper season.

(a) *Utilization of culturable waste lands and current fallows:* The best way to increase the acreage in jute would be to utilize portions of the huge tracts of culturable waste lands and current fallows lying in the four different jute-growing districts of the provinces of West Bengal, Assam, Bihar and Orissa.

More or less three bales per acre may be expected from these new lands and so we would require 1·25 million acres of land to produce 37·4 lakhs of bales.

The Government of Bengal in 1944-45 undertook a plot to plot survey of all lands in the province including the culturable wastes and current fallows. The result of the enumeration published recently shows that in West Bengal* (all the 12 Districts and Siliguri sub-division of Darjeeling District) there are 520,009 acres of current fallows and 1,964,727 acres of culturable wastes. The analysis of the culturable waste lands given below will show that an area of approximately 1,361,288 acres of land are fit for immediate cultivation.

Culturable waste lands in West Bengal (1944-45)

Culturable wastes	1,361,288
Bheta, etc.	110,293
Grazing ground	125,800
Jungle	300,423
Playing ground and camping ground	22,727
Others if any	44,196
Total ...	1,964,727

None of the other three provinces undertook any such plot to plot survey.

The following figures for Bihar and Orissa are obtained from the Agricultural Statistics published by the respective Directors of Agriculture:

Bihar (1940-41)

Net cropped area	7,692,800
Current fallows	2,128,700
Uncultivated land excluding current fallows	3,150,816

Orissa (1942-43)

Net cropped area	2,692,098
Current fallows	478,719
Uncultivated land excluding current fallows	881,938

No up-to-date records of culturable waste lands in the districts of Assam are available. Even a moderate estimate based on old records shows that more than five million acres of culturable waste lands are available in the six jute-growing districts of the Brahmaputra Valley. The conditions there are nearly similar to those of Eastern Bengal and so a large portion of these culturable wastes can be brought under jute cultivation. There is thus immense possibility of extending jute cultivation in Assam.

The acquisition of culturable waste and current fallows has to be done by the Provincial Governments. I understand the Government of West Bengal are considering to acquire certain portions of culturable waste lands to extend cultivation. After acquisition they propose to invite applications for cooperative settlement of the blocks of waste lands and assist the colonists with capital to be recovered in instalments over a number of years. Although the Government of West Bengal are planning to reclaim waste lands, they have, as far as I am aware, as yet no cropping scheme for these lands on jute cultivation.

The policy of the other three provinces, viz. Bihar, Orissa and Assam regarding the reclamation of waste lands and extension of jute cultivation is not known.

As it is desirable not to decrease any area under food crops for the extension of jute cultivation, the question of reclamation of waste lands must be taken in hand as early as possible. Lands remain uncultivated mainly for three reasons: (1) lack of money, (2) lack of men and (3) unhealthy conditions. All these particulars of the waste lands as also their ownership rights, topography, irrigation and other drainage facilities, soil condition, and the nature of the preliminary breaking up of the land required for cultivation have to be determined. All these, however, can be ascertained by the Provincial Governments through their District and Special Agricultural Staff in course of a few months.

Soils on which jute is grown are almost entirely alluvial. There are old and new alluvial soils. The new alluvium (grey silt) is mainly found near large rivers especially in their deltas and is very good for jute cultivation. The old alluvium is a poorer type of soil. In East Bengal considerable quantities of jute are produced on the high land of the old alluvium. In the Indian Union the soils of parts of Orissa, South Bihar and parts of the Burdwan Division belong to old alluvium. The soils of the whole of North Bihar and parts of Burdwan and Midnapore Districts in West Bengal and Balasore in Orissa are akin to the new alluvium. The new alluvium can also be obtained in large parts of Assam (Brahmaputra Valley).

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* Details of the waste lands and current fallows are given in Tables II, III and IV.

Jute is a rainy season crop. Damp heat is most favourable for its growth. From one to three inches of rain distributed in a month during sowing period may be considered sufficient. Occasional showers of rain, varying from one to two inches, at intervals of about a week are most beneficial for the growth of the plants. Temperature of the areas where jute is grown hardly exceeds, during the growing season, 100°F. and falls below 60°F. Humidity varies from 65 to 91. All these conditions can be had in all the jute-growing districts where huge areas of waste lands are lying uncultivated.

It is, therefore, seen that the extent of the area in the Indian Union having proper soil and climatic condition is much larger than that on which jute is grown at present.

Retting facilities available in the waste lands and current fallows of the jute-growing districts of India are not definitely known. It is expected that there will not be much difficulty in this respect. If arrangements for irrigation are made, there will, however, be no difficulty for retting.

It is suggested that a thorough survey of the soil and climatic conditions and retting facilities should be carried out to find out the particular areas where jute can be grown with the help of the Agriculture Departments of the Provincial Governments, before taking definite steps in the matter of extension of jute cultivation in these areas.

(b) *Extension of jute cultivation in other provinces and States:* Jute cultivation may be extended to other provinces besides West Bengal, Bihar, Orissa and Assam. No serious attempt has ever been made for the extension of jute cultivation in other provinces where proper conditions also exist for growing jute.

The cultivation of jute in the United Provinces was started early in 1921 and as many as nine districts have been growing jute since then in more than 12,000 acres. The districts of Kheri and Sitapur are the main jute-growing districts in the United Provinces.

In 1939 there was an area of 7,569 acres under jute in Kheri District, and about 2,500 acres in Sitapur. The cultivation of jute was restricted, otherwise the area would have been much more than that. The Government of the United Provinces are considering to develop new areas in the Kheri District for cultivation of jute.

Mr. Finlow reported that jute could be successfully cultivated in Madras and Bombay in the following areas :

Madras Presidency—Malabar, South Kanara and Ganjam (now in Orissa) Districts.

Bombay Presidency—(a) Irrigated areas around Poona.

(b) The most westernly portion of the Deccan and Karnatak especially the latter, i.e. at Belgaum and west of Dharwar.

(c) The higher lands of the Konkan.

In Malabar and Kanara the cilmatic conditions are very suitable for jute cultivation. There are also very good retting facilities.

It cannot now be definitely ascertained as to how much area of these provinces can be brought under jute cultivation. But we may expect that in these provinces sufficient culturable wastes or fallow lands will be available for cultivating jute. If the varieties of jute grown in Bengal, Bihar, Assam and Orissa do not grow well there, it will be possible to evolve new strains suiting these localities.

Cooch Bihar and Tripura, the two States of Bengal, grow a certain amount of jute. It is possible to extend jute cultivation in these States, especially in the former. Besides, it may be possible to extend jute cultivation in some of the States of Orissa and Central India.

(c) *Double cropping and maximum utilization of land: Capsularis* jute can be easily grown in rotation with *aman* paddy in such places where there is early rainfall or proper arrangement for sufficient water supply (irrigated areas) and which are not flooded with river water in July-August. In Eastern Bengal and Assam a very large area of the finest jute land is double-cropped with *Capsularis* jute (sown in March-April and reaped in July-August) and transplanted *aman* paddy, planted as soon as the land can be prepared after the harvesting of jute. This system can be extended to certain other areas of the Indian Union where there is early rainfall, by a proper method of land management and by growing the quick-yielding variety of *Capsularis* jute evolved by the Jute Agricultural Research Laboratories. Thus it will be possible to increase jute acreage to some extent by practising the system of double-cropping in suitable *aman* paddy lands of the Indian Union, where it is not now followed.

(d) *Irrigation facilities:* In such areas which have soil and other conditions suitable for growing jute, but have not the rainfall at the proper season, jute may be grown provided the fields are brought under irrigation. Considerable portions of the culturable wastes can be brought under cultivation by this method.

How extension of jute cultivation can be implemented

It has been estimated that about 1·25 million acres of additional land will be required to achieve our end. It may not be possible to acquire all these lands in the different provinces within a year for the extension of jute cultivation. Even if the land can be obtained, the amount of seed sufficient to sow all these areas will not be obtained. We shall, therefore, have to proceed by stages. It will be satisfactory if 25 per cent of the areas can be brought under cultivation in the first year. If all things work in our favour, it may be expected that by four or five years we shall be able to produce enough jute to meet our requirements.

Varieties of jute grown in India and their quality

Varieties of jute grown in the Indian Union: In the Indian Union both white (*Capsularis*) and tossa (*Olitorius*) jute is grown, while Pakistan produces mainly white jute. The position of two varieties of jute in the Indian Union is roughly shown in the following Table.

It would appear from the Table that *Capsularis* and *Olitorius* were grown during 1947 in Indian Union in the proportion of 69 to 31. By applying the same proportion to the total output it is found that approximately 1,16,340 bales of *Capsularis* and 5,32,500 bales of *Olitorius* jute have been produced in India during the current season.

Name of Province or State	Percentage of area in 1937-38*		Calculated acreage	
	Capsularis	*Olitorius*	*Capsularis*	*Olitorius*
1. West Bengal	43	57	98,545	1,30,630
2. Tripura State ..	82	18	9,010	1,990
3. Cooch Bihar	100	—	37,210	—
4. Bihar (including Nepal) ..	59·4	40·6	85,210	58,546
5. Assam ..	97	3	1,96,522	6,078
6. Orissa ..	94	6	20,210	1,290
Total			4,47,150	1,98,535

*Marketing Enquiry figures.

The requirements of the mills: About 95 per cent of the total goods manufactured by the Indian mills consists of hessian and sacking for which the mills require certain type of jute. About 80 per cent of the jute consumed by the mills comes from the districts of East Bengal. Out of this 76 per cent consists of white jute and 4 per cent tossa, the remaining 20 per cent of their requirement which is mostly of white jute is supplied by the Indian Union.

Quality of jute produced in India: Now it is to be considered whether the increased quantity of jute to be produced in the Indian Union will be as such suitable for consumption by the mill. The complaint against most of the jute produced in Indian Union is that it lacks in good colour and it is not of good quality. The quality of a fibre is judged by its strength fineness, colour including uniformity of colour, lustre, length, proportion of roots and freedom from fault. The single biggest factor that affects the quality of the fibre is retting. Most of these defects can be rectified by improving the technique of retting. The Jute Agricultural Research Laboratories have already ascertained the causes for the defects in fibres due to retting and have recommended simple methods to be employed during retting, which will ensure good retting, thereby producing fibre of good quality.

The Technological Research Laboratories have determined the quality ratios of yarns spun from some commercial samples obtained from different places of Indian Union and

Pakistan. It has been found that the quality ratios of *Capsularis* jute samples obtained from Kishengunge (Purnea), Jalpaiguri (Bengal), Cuttack (Orissa) and Dhubri, Goalpara, Kamrup (Assam) are as good or nearly as good as jute from the best jute areas like Mymensingh, Tipperah and Dacca Districts. The tossa jute grown in Purnea, Kishengunge (Bihar), Cuttack (Orissa) and in a few districts of West Bengal and Assam are of very good quality (*Annual Report*, Technological Research Laboratories, 1933-34).

Quality ratio of jute grown in Indian Union

		White Quality ratio of 10 lb. yarn	Tossa Quality ratio of 10 lb. yarn
Bihar			
Kishengunge	...	97	114
Orissa			
Cuttack ...	...	103	109
Assam			
Dhubri ...	...	101	117
Goalpara ...	...	98	109
Kamrup ...	...	97	...
West Bengal			
Jalpaiguri	...	99	...
Chanditollah	...	...	110
Naghee ...	...	...	110
Jhapandi ...	...	...	99
Sheoraphuli	...	...	102
Koilaghat ...	...	...	111

It will be seen from the foregoing Table that jute grown in many parts of the Indian Union does not suffer from low quality ratio. Yarns of very good quality can be produced out of these. But this jute is not preferred on account of the lack of good colour. The cause of the inferior colour has been determined and it will be possible to improve the colour of the jute. What is wanted is propaganda among the cultivators for adopting the improved methods of retting recommended by the Jute Agricultural Research Laboratories.

In extending acreage attempts will be made to grow white jute as possible. But a quantity of tossa jute at present produced or to be produced later on will have to be used by the mills, as under the present circumstances not much export will be possible.

The mills use only a small quantity of tossa jute. Tossa has a yellowish, reddish or a greyish shade depending upon the nature of the retting water and on account of this it is not much used in making hessian cloth. It may be said that the finest yarn that has ever been produced in respect of strength and regularity, has been made from tossa jute. Dundee mills use a large quantity of tossa jute for making yarns for carpet and canvas.

The Indian mills prefer the white colour of *Capsularis* jute for making hessian, because the foreign buyers prefer white hessian for the simple reason that stamps impressed on bags look much better on a white background. This long-standing colour prejudice should be removed and some amount of propaganda should be made that bags made of tossa yarns are much stronger than those made from white yarns.

Cost of production of jute in the Indian Union

It may be assumed that the cost of production of jute in the extended areas will be much higher than that in Pakistan on account of the additional cost of manures, irrigation and improved seeds to be used for these areas and as a result the price of jute in the Indian Union may be higher than that of Pakistan jute. No doubt some additional cost will be involved for manures, irrigation (where necessary) and improved seeds but the cost of cultivation may be cut down to a great extent by adopting improved methods of agriculture. The process of weeding and thinning where every inch of the land is covered by hand labour, usually for three times in one jute season, is very expensive and accounts for more than half of the total cost of production. The cost would be much reduced if weeding could be done by hand-wheel hoes, instead of by hand labour. Therefore, with the object of reducing cost of production by cutting down the cost of weeding and thinning to the minimum, the possibility of growing jute in lines was tried at Dacca and other places during the past few years.

The yield per acre, cost of cultivation and the profits are given in the following Tables for *Capsularis* and *Olitorius* respectively from experiments conducted in 1945-46 and 1946-47.

Yield and profit in broadcast and line-sown plots, 1945 C. capsularis (D. 154)

Treatment	Cultivation cost per acre. Total in Rs.	Per cent on control	Yield per acre in md.	Profits in Rs. (fibre valued at Rs. 15 per md.)
Broadcast (control)	131	100	14·4	85
Light-thinned	96	73·3	13·2	102
2 in. × 12 in.	102	77·8	13·1	94
3 in. × 12 in.	100	76·4	12·4	86
4 in. × 12 in.	101	77·1	11·9	78

C. olitorius (C. G.)

Treatment	Cultivation cost per acre. Total in Rs.	Per cent on control	Yield per acre in md.	Profits in Rs. (fibre valued at Rs. 15 per md.)
Broadcast (control)	138	100	13·1	58
Light-thinned	97	70·3	13·0	98
2 in. × 12 in.	111	80·4	13·7	95
3 in. × 12 in.	106	76·8	12·6	83
4 in. × 12 in.	106	76·8	13·3	94

Experiments in 1946

C. olitorius trials (Chinsurah Green)

(1) Dacca

Treatment	Cultivation cost per acre. Total in Rs.	Per cent on control	Yield per acre in md.	Profits in Rs. (fibre valued at Rs. 25 per md.)
Broadcast	234·8	100·0	12·0	65·2
No thinning × 12 in.	156·5	66·6	11·3	126·0
2 in. × 12 in.	156·0	66·4	12·2	149·0
3 in. × 12 in.	158·3	67·4	11·3	124·2
4 in. × 12 in.	154·6	65·8	11·5	132·9

C. capsularis trials (D. 154)

(1) Rangpur

Broadcast	247·0	100·0	13·7	95·5
No thinning × 12 in.	202·8	82·1	12·3	104·7
2 in. × 12 in.	194·0	78·5	11·3	88·5
3 in. × 12 in.	181·7	73·5	10·2	73·3
4 in. × 12 in.	174·3	70·5	12·6	140·7

At Rangpur wheel-hoe was not employed for interculture in the line-sown plots; otherwise the cost of production would have been further reduced and the profit from these plots would have been increased.

The results of the experiments given in the preceding page show that line-sowing is much more economical than broadcast and in line-sowing the cost of cultivation can be reduced by about 25 per cent. Besides, the use of manures and improved seed will result in increasing the yield. This together with the reduction of cost of cultivation by adopting improved methods of agriculture will more than balance the additional cost involved in manures, irrigation (if necessary) and improved seeds.

It is now found that Pakistan has imposed a duty of Rs. 3 per maund on the export of raw jute beyond her borders. As a result the cost of Pakistan jute will be much higher than that of Indian jute. Moreover, the 'Agreement Steamer Companies', having decided to increase the freight on raw jute, the cost of transport of jute from Eastern Bengal is going to increase considerably in the near future.

It is expected that a large quantity of jute will have to be transported by rail from Assam. This will entail a slight increase in the cost of raw jute in Calcutta. The Government of India should, therefore, come forward to give facilities for the transport of raw jute from Assam to Calcutta.

It is also estimated that the cost of production in Assam, where conditions are nearly similar to those in East Bengal, will not be very high and as such the increased cost of transport will be more than compensated.

The seed position

Before taking definite steps towards the extension of jute cultivation, provision should be made for the supply of sufficient quantity of improved seed to the growers. The present seed position in the country appears to be not very encouraging. The Government of Bengal who used to grow seed through an agent, has this year made no arrangement for growing seed.

Although most of the cultivators realize the value of improved seeds, they cannot go in for them, because of the high price. This coupled with the inadequate quantity of seeds available for distribution stand in the way of extension of improved jute area. The Provincial Governments should, therefore, not only arrange for the multiplication of improved seeds but also sell them at a reasonable price.

Present position : According to an enquiry conducted by the Marketing Department, 74·5 per cent of the All-India jute acreage in 1937-38 was under *Capsularis* and 25·5 per cent under *Olitorius*. According to departmental estimates made more than 10 years ago, 33 per cent of the total *Capsularis* area is under D.154 and about 75 per cent of the *Olitorius* area is under the strain Chinsurah Green. At present it appears that much less area is under improved strains, as the agencies for supplying improved seeds did not work very well during the last few years.

The growers generally utilize a part of their crop for seed production. According to an enquiry made by the Marketing Department, the average area retained for seed was 4·1 per cent of the total acreage under jute. Seeds produced on this area are quite sufficient to meet the normal demands. But it is not known whether any improved seeds have been grown in this area or if at all grown, in how much of this area.

Method of production and distribution of seed by the Government of Bengal: In 1923-24 Messrs. A. L. Godden and Co. of Naraingunge was appointed Agent of the Government of Bengal to produce and sell Government jute seeds. The Agent arranged to grow a quantity of D.154 and C.G. (departmental improved strains) seed in Bihar by some planters. The planters were supplied with *bona fide* Government jute seed from a nucleus supplied by the Department initially. The seed crop was inspected by officers of the Fibre Section of the Department of Agriculture, Bengal. The growers or the planters had to be approved by the Government of Bengal and were paid by the Agent. This system was followed up to 1946-47. The Government of Bengal discontinued it as they intended to grow jute seed by their own officers in seed multiplication farm at Dinajpur.

The entire work of distribution of the improved jute seed was up to this year (1947) done by Messrs. A. L. Godden and Co., the Government Agent.

The price at which the seed was purchased from growers was subject to the approval of the Director of Agriculture, Bengal. The sale price was also fixed by the Bengal Agricultural Department. This year prices were Rs. 60 per maund of D.154 and Rs. 75 per maund of C.G. seed.

The above system did not work very well and only a small quantity of seed of improved strains was produced and sold to the cultivators, as will be seen from the following Table.

Years	D.154 (md.)	C.G. (md.)	Total
1923–24	2765	486	3251
1924–25	2000	408	2408
1925–26	2000	800	2800
1926–27	2532	1176	3708
1927–28	1774	295	2069
1928–29	1950	295	2245
1929–30	2000	670	2670
1930–31	negligible	500	500
1931–32 to 1940–41 (Average annual)	..	..	683*
1943–44	594	470	1064
1945–46	270	206	476
1946–47	192	196	388

*Detailed figures not available.

The seed rate recommended by the Department of Agriculture, Bengal, is 4·5 seers for *Capsularis* and 3 seers for *Olitorius* per acre. Based on the seed rate, in 1926-27, a year in which the sales of Government seed were the largest, about 37,000 acres, i.e. a little over one per cent of the total area under jute could have been sown with improved seed. In 1935-36 the sales of the jute seed were the lowest, only 245 md. being sold, and so less than 0·01 per cent of the total area under jute would have been covered with improved seed in that year.

Production and distribution of jute seed by other provinces: Till recently the provinces of Orissa and Assam did not do much by way of producing and distributing improved seeds. Since 1943 the Government of Orissa have been growing small quantities of improved seeds through certified farmers and have been receiving a small grant from the Indian Central Jute Committee for this purpose. Assam imports only 24 md. of improved jute seed annually from Messrs. A. L. Godden and Co., the Bengal Government jute seed Agent. From this year (1947-48) they will grow only 50 md. of jute seed in a small seed farm of their own and for this purpose they will receive a small grant from the Indian Central Jute Committee. It is not known if the Government of Bihar grow any improved seed of jute.

Multiplication of improved jute seed: For the production and distribution of seeds of improved strains in the Indian Union it is very necessary that a number of large seed multiplication farms should be established as early as possible. It has been estimated that 1·25 million acres of additional land will be required for the extension of jute cultivation. Besides this, 0·646 million acres of land are already under jute. It may be expected that some of this area is already covered with improved seed. It may therefore be said that improved seeds will be required roughly for 1·75 million acres of land. The seed rate for tossa (*Olitorius*) jute is 6 lb. and for white (*Capsularis*) jute is 10 lb. per acre. If equal acres under white and tossa jute are sown, then we would require 170,732 md. of jute seeds. If improved seeds are supplied for only 25 per cent of the total areas (1·75 million acres) under jute, then 42,688 md. of jute seed will be required. In a hundred-acre farm it is estimated that about 400 md. of jute seed can be produced which would be sufficient to sow approximately 4,000 acres of land. It will, therefore, be seen that as many as 106 such farms will be required to meet only 25 per cent of the demand of seed.

It has, however, been found that most of the cultivators keep their own seeds. The cultivators who will be supplied with improved seeds may be asked to grow their own seeds in order to meet their seed requirements. This will ensure regular multiplication of improved seed through the cultivators themselves.

It is very necessary that each jute-growing province in the Dominion should have seed multiplication farms under the direct control of the Provincial Directors of Agriculture and there should be proper agencies for the distribution of improved seeds to the cultivators. The province of Bihar offers most suitable land and other conditions for producing good seeds. In fact the supply of improved departmental seeds in Bengal has hitherto been obtained mostly from Bihar.

It is suggested that 10 seed multiplication farms, each with an area of 300 acres, be established in the four jute-growing provinces in the following order : Bihar 4, West Bengal 3, Assam 2 and Orissa 1. These farms may be run under the control of the Provincial Directors of Agriculture with the technical guidance and direction of the Director, Jute Agricultural Research. A large sum of money will be required to establish such farms. The Indian Central Jute Committee may assist the Provincial Governments in financing the establishment of jute seed multiplication farms. Recurring cost of the farms may be met from the sale proceeds of the seeds and the income from *rabi* crops to be grown during the off-season.

The ten proposed Government farms will produce about 12,000 md. of jute seed which will be sufficient to sow only about 1,20,000 acres of land. Even then there will be deficit of a huge quantity of seed. This may be met by growing seeds through a number of registered growers as was done by the Bengal Government jute seed Agent or as done in the Punjab in regard to the growing and distribution of improved cotton seeds (as explained by the President in the 21st meeting of the Indian Central Jute Committee held on 22 January 1947). The Provincial Governments will give certified improved seed to certain registered growers who will use these seeds for the production of the crop under the supervision of the officers of the Provincial Departments of Agriculture. After the seeds are harvested, the Provincial Agricultural Officers will give a certificate that the seeds are pure. The Provincial Departments of Agriculture will then purchase those seeds at a premium and arrange for their distribution.

In the province of Bihar there are many planters who have been growing jute seed for a number of years. There are a few planters also in Bengal and Assam. A number of them may be employed for the purpose of growing improved seed.

Conclusions

It will thus be seen that by proper planning and careful land management it will be possible to extend jute cultivation and produce enough jute of good quality and colour in the Indian Union without decreasing the acreage under food crops. Necessary area can be obtained and the extension will not be inhibited by lack of soils and other conditions. Some amount of propaganda will, however, be necessary at the initial stages of the extension of jute cultivation.

The seeds grown by the Bihar planters which are expected to be in their stock now, if utilized towards meeting the requirements arising out of extended cultivation of jute will, it is hoped, meet about 5 per cent of the requirement. If they are asked to grow more jute seed next year we may expect better returns from these Bihar planters, say to cover about 10 per cent or more of our requirement for extended areas.

It may not be possible to step up production within one year on account of two main reasons: (i) the difficulties of bringing the entire required area of cultivable waste lands under cultivation in a short time and (ii) lack of supply of improved seed (or of any seed) for the extended areas. We shall, therefore, have to proceed by stages. We may expect to achieve our end in about four or five years. What is wanted is a planned drive in cooperation with all the Provincial Governments.

It will, however, be essential to maintain a properly equipped Agricultural Research Institute with a farm or farms to evolve higher yielding types, to improve method of agriculture, to devise control measures for diseases and pests and to improve the quality of the fibre by better methods of retting and to make soil studies.

TABLE I

Area, output and yield in districts of Indian Union and Pakistan

	Area (1000 acres)			Output (1000 bales)			Yield per acre		
	1940	1946	1947	1940	1946	1947	1940	1946	1947
West Bengal									
24-Parganas	96	29	41	214	94	98	2·2	3·2	2·4
Navadwip	57	17	22	127	50	61	2·2	3·0	2·7
Murshidabad	116	27	44	186	85	92	1·6	3·2	2·1
Burdwan	20	3	6	43	11	17	2·2	3·7	2·9
Birbhum and Bankura	1	..	..	2	1	1	2·0	..	..
Midnapur	24	7	11	63	21	25	2·6	3·0	2·2
Hooghly	62	19	27	112	61	80	1·8	3·2	3·0
Howrah	16	3	5	38	11	18	2·4	3·7	3·4
West Dinajpur	38	10	16	69	32	46	1·8	2·9	2·9
Jalpaiguri	59	18	26	165	46	60	2·8	2·6	2·3
Darjeeling	6	1	2	15	4	4	2·6	3·3	2·0
Malda (portion)	74	18	28	150	57	48	2·0	3·1	1·7
Total	569	152	228	1184	473	550	2·1	3·1	2·4
Cooch Bihar	48	27	37	123	57	99	2·6	2·2	2·2
Tripura	18	10	10	43	25	26	2·4	2·1	2·4
Total	66	37	47	166	82	125	2·5	2·2	2·6
Bihar									
Champaran	3	3	3	8	8	8	2·7	2·7	2·7
Muzaffarpur	6	4	4	13	9	9	2·2	2·3	2·3
Darbhanga	1	1	1	1	1	1	1·0	1·0	1·0
Bhagalpur	12	5	6	26	11	13	2·0	2·2	2·6
Purnea	261	132	131	522	220	370	2·0	1·7	2·8
Santal Parganas	1	1	1	1	2	2	1·0	2·0	2·0
Total	284	146	146	571	451*	440*	2·0	1·7	2·8
Orissa									
Cuttack	26	21	20	48	50	40	1·8	2·4	2·2
Baleswar	2	2	1	3	5	3	1·5	2·5	3·0
Puri	1	1	...	1	3	1	1·0	3·0	..
Total	29	24	21	52	58	44	1·9	2·4	2·1
Assam									
Cachar (Plain)	..	..	..	1	1	1	..	..	..
Goalpara	112	59	70	274	141	190	2·4	2·4	2·7
Kamrup	71	47	50	199	128	128	2·8	2·7	2·6
Darrang	29	18	18	77	57	59	2·7	3·1	2·7
Nowgong	86	47	55	211	104	141	2·5	2·2	2·6
Sibsagar	1	1	1	3	2	2	3·0	2·0	2·0
Lakhimpur	3	2	2	11	8	9	3·0	3·0	4·0
Garo Hills (Plain)	6	6	6	10	15	16	1·7	2·8	2·7
Sylhet	7	..	..	20	..	..	2·9	3·7	..
Total	315	180	202	806	456	536	2·6	2·5	2·6
Total in Indian Union	1263	539	645	2229	1520	1695	2·2	2·4	2·6
Total in Pakistan*	4410	1374	2059	10393	4128	6842	2·4	3·0	3·3

*Includes estimated imports from Nepal.

TABLE II

Distribution of lands in West Bengal (1944–45)

(According to Agricultural Statistics by plot to plot enumeration in Bengal, 1944-45, Part I)

Districts	Total area	Unculturable waste land	Culturable waste land	Current fallows	Net cropped area	Area under jute	Jute in per cent of net cropped area
1. 24-Parganas	2281749	391671	220323	74633	1600537	35390	2·21
2. Navadwip	994369	118361	165486	29419	702279	21583	3·07
3. Murshidabad	1310324	195345	155094	26939	946547	33257	3·51
4. Burdwan	1724306	314426	196242	61117	1159928	4691	0.40
5. Birbhum	1113051	193405	107403	17145	798372	86	0·01
6. Bankura	1693885	306470	283575	99349	1014158	173	0·02
7. Midnapur	3269072	597665	361296	72445	2267841	9397	0·41
8. Hooghly	766040	132537	55516	16525	563288	27800	4·93
9. Howrah	335390	66067	14512	7367	248809	4244	1·70
10. West Dinajpur	885425	101743	80641	40261	659593	16254	2·46
11. Jalpaiguri	1378679	419553	212630	65713	729313	23169	3·18
12. Maldah	875992	122512	78675	9096	654534	22896	3·50
13 Darjeeling (Siliguri Sub-division only)	1052798	16507	33354	..	110096	1704	1·55
Total	17681080	2976262	1361288	520009	11455395	200644	1·8

TABLE III

Analysis of the culturable waste lands in West Bengal

(According to Agricultural Statistics by plot to plot enumeration in Bengal, 1944-45, Part I)

Districts	Culturable waste	Bheta, etc.	Grazing ground	Jungles	Playing ground and camping ground	Other if any	Total
1. 24-Parganas	163369	10186	1561	32974	5977	6256	220323
2. Navadwip	127940	16574	562	16033	1861	2526	165486
3. Murshidabad	116197	17826	5815	11695	453	3108	155094
4. Burdwan	127145	7696	19006	22459	7135	12801	196242
5. Birbhum	81615	2363	6933	14410	87	1995	107403
6. Bankura	227032	1483	11119	41513	271	2157	283575
7. Midnapur	277010	14900	33572	28219	3416	4179	361296
8. Hooghly	34853	3078	2837	12379	460	1909	55516
9. Howrah	12058	544	190	1351	206	163	14512
10. West Dinajpur	45614	5992	5131	21691	1020	1203	80641
11. Jalpaiguri	94005	12710	29567	70430	1095	4823	212630
12. Maldah	47658	13498	2513	11464	664	2878	78675
13. Darjeeling (Siliguri Sub-division only)	6792	3443	6994	15815	92	198	33334
Total	1361288	110293	125800	300423	22727	44196	1964727

TABLE IV

Current fallows and waste lands and area under jute in the jute-growing districts of Bihar and Orissa

Bihar (1940–41)	Net cropped area (acres)	Current fallows (acres)	Uncultivated land excluding current fallows (acres)	Area under jute	Jute in per cent of net cropped area
Champaran	1423600	6600	427566	2500	0·18
Muzaffarpur	1059000	568000	118904	5500	0·52
Darbhanga	1400500	267400	501341	800	0·06
Bhagalpur	1167000	517100	432000	11700	1·00
Purnea	1132100	562300	1177101	261000	23·05
Santal Parganas	1510600	207300	693905	600	0·04
Total	7692800	2128700	3150816	282100	3·67
Orissa		1942–43		1940–41	
Cuttack	1082440	313360	430300	26200	2·42
Balasore	894300	71100	185200	1720	0·02
Puri	715358	94259	266438	513	0·07
Total	2692098	478719	881938	28433	1·00

—Reproduced from *Jute Bulletin*, January 1948.

IMPROVEMENT IN FRENCH PRODUCTION

JUTE mills in France produced a total of 6,102 tons of jute yarn, during the month of March 1948, or 10 per cent more than in the month previous. Jute fabric output increased from 3,800 to 4,400 tons.

Raw jute imports totalled 3,270 tons in March. Previous months' average, however, was much better. The French stocks of raw jute registered a further decline of 3,322 tons at the end of March from 1,567 tons at the end of February. —*I.C.J.C.*

Book Reviews

FARM SCIENCE AND CROP PRODUCTON IN INDIA

By C. P. DUTT and B. M. PUGH (Published by Kitabistan, Allahabad, 1947, pp. 240, Rs. 12).

THIS is the second edition of the book but the original name 'Crop Production in India' has been somewhat modified.

As in the first edition, the book is divided into two parts but here also the title has been changed. Part I has been named 'Farm Science' in place of 'General Principle of Crop Production', and Part II 'Crop Production in India' in place of 'Field Crops'. Both parts have been separately paged. The more welcome change in the book is its size which has now become handier, smaller and lighter. The portions dealing with statistical method and laying out of field experiments have been deleted. The older data on crop and other statistics have been replaced by newer ones (1941) but it would have been more helpful if the more recent data on the basis of Indian Union and Pakistan had been included. Such data are available. Another omission here is that whereas the newer statistics have been taken largely from 1941 data, the corresponding correction has not been made in the bibliography under the different chapters where generally the reference is to the older publication as given in the first edition. In Table V, page 33, some of the botanical names are older ones. They differ from those given in the *Kew Bulletin* by Sampson. They should be suitably corrected. In this Table 'common names' have been given. It would have helped the readers of the different provinces if the important vernacular names had been included either here or separately in the chapter dealing with individual crops.

In part II, page 14, the total estimated yield of wheat has been given at 12 million tons (324 million md.). On the other hand in Table III, page 11, the production of wheat has been shown at 257·275 million md. Evidently both these data have been taken from different sources or possibly there is some error. Similar checking is also needed in the case of other data and as they are of very great importance the author's attention is invited to them.

Under maize there is no mention about the recent development on hybrid maize. Under minor oilseeds mustard crop has been included. I do not know on what ground it has been considered as minor oilseed as both mustard and mustard oil are of major importance all over Northern India.

The authors have produced a useful book but it would have been much better if they had confined their attention to the main aspect of crop production instead of attempting rather too many things.

In citing references the authors should do it on the basis of latest books and periodicals. Here too there is much room for improvement. (I.C.)

GHEE PRODUCTION IN INDIA

THE annual production of *ghee* in India is estimated at over 5 lakh tons valued at Rs. 77 crores*. Of this quantity nearly 62 per cent is produced in Indian provinces and the balance in States. In order of importance the main *ghee*-producing areas are the Punjab, the United Provinces, Madras and Bihar which account for 15·7, 13·8, 9·8 and 5·4 per cent of the total production respectively. Thus three-fifths of the *ghee* production is concentrated in Northern and Western India and the remaining two-fifths is scattered in the rest of the country. Taking the country as a whole India produces 8·9 maunds of *ghee* per square mile, 21·4 maunds per village, and 3·6 maunds for hundred persons. The annual *per capita* consumption of *ghee* in India is highest in Gwalior and Sind with 15·5 and 11·2 seers respectively and lowest in Hyderabad and Bengal with 1·1 and 1·3 seers respectively. These interesting facts are revealed in the *Ghee Marketing Report* issued by the Directorate of Marketing and Inspection of the Government of India.

Of the total *ghee* production nearly 30 per cent is retained by the producers for domestic consumption and 70 per cent is marketed. These percentages however vary from tract to tract, depending upon variable factors like the type and status of the producer, proximity to a *ghee* market, kind of diet in a tract, etc.

India imports about 66,000 maunds of *ghee* mostly by land-frontier routes from Nepal, but the trend of imports has, during the past few years, shown a slight downward tendency.

India also exported about 66,000 maunds valued at a little over Rs. 30 lakhs mainly to the Straits Settlements, Burma, Federated Malay States and to Africa. It is stated that there are possibilities of expanding the export market for *ghee* when normal conditions return. But this should be encouraged when present production is increased to a level beyond self-sufficiency and only graded *ghee* of good quality should be exported.

The quality of *ghee* and its prices vary widely. The latter depends on the physical characteristics of the product, its purity, type, grade, variety and intensity of demand, but by far the most important factor affecting price is purity.

Even before the commencement of the war, prices of *ghee* showed a steady upward tendency but in 1943 the prices registered in some cases, a 100 per cent rise over the 1938 prices. This increase was in sympathy with a general rise in the prices of food articles as a result of abnormal conditions created by the war.

To enable consumers, to obtain supplies of pure *ghee* the Directorate of Maketing and Inspection inaugurated its Agmark scheme in 1937 which has progressed steadily. In 1944 the total number of grading stations in the country was 59 and the total value of the *ghee* graded was Rs. 5,70,00,000 as against Rs. 15,00,000 in 1938. Even so only 4·5 per cent of the marketable surplus is agmarked. To be of greater benefit to producers, grading should be undertaken on a cooperative basis.

Some of the other main recommendations are :

1. The production and consumption of *ghee* should be accelerated by increasing milk production and by the introduction of improved methods of milk fat extraction under village conditions.
2. The units of sale should be standardized by a rigid enforcement of the Weights and Measures Act.
3. A regular system of controlling *ghee* markets should be introduced by the establishment of Regulated Markets and cheap credit facilities should be provided to producers by organizing cooperative *ghee* sale societies.

---

*Calculated at a flat rate of Rs. 55 per maund (1940).

4. To ensure uniformity in the different provinces in the enforcement of food control laws, Provincial Governments should promote central legislation for the hygienic control of food production, distribution and sale.

The Report contains a large number of appendices relating to *ghee* production, consumption and sale. (*P.I.B.*)

HERB-CULTIVATION IN THE NETHERLANDS

BY herb-cultivation is understood the cultivation of medicinal, aromatic and kindred crops, the special characteristics of which were already well-known in ancient times.

Before second world war, herb-cultivation and, especially, herb-marketing, was of some consequence. The world turn-over of herbs, a large part of which was accounted for by Germany, amounted to about 500 million dollars in 1938.

After the war a moderate amount of interest was shown in herb-growing in the Netherlands. The areas that are under cultivation at present are in the province of Friesland (about 190 acres) and in the northern part of the province of Gelderland (about 125 acres).

It is only natural that at present, in its early stages, the cultivation of herbs is looked upon as something of a side-line.

The harvested herbs have to undergo various treatments before they are suitable for use. The chief of these is the drying process, which is costly, a special installation being required for the purpose, as gradual and even drying is essential for the preservation of the active properties of the herbs. To promote cultivation the Netherlands Government has granted a subsidy for the building of a drying installation in Friesland and another in Gelderland.

Much attention is being given to improvement of quality, and therefore exports of inferior quality will be out of the question. —*Summary of a note received from Royal Netherlands Embassy.*

COVER ILLUSTRATION

Cultivation in the hills of Kashmir.

INDIAN FARMING

ISSUED BY
THE INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Vol. IX : No. 12
DECEMBER 1948

Subscription : Rs. 6 per annum : 8 as. or 9d. per copy

PUBLISHED BY THE MANAGER OF PUBLICATIONS, DELHI
PRINTED AT THE JOB PRESS LTD., KANPUR

ICAR—21.12.48
2,800

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Articles, photographs, books and periodicals for review and editorial communications should be addressed to the Editor, Indian Council of Agricultural Research, New Delhi.

The subscription is Rs. 6 per annum, 8 as. per copy, inclusive of packing and Indian postage. Enquiries and remittances relating to subscriptions and advertisements should be made to the Manager of Publications, Civil Lines, Delhi.

Subscribers in Europe and America should apply to the High Commissioner for India, Public Department (Publication Branch), India House, Aldwych, London WC 2.

INDIAN FARMING

DECEMBER, 1948

Vol. IX No. 12

DEVELOPING INDIAN FISHERIES*

Friends and co-workers

I AM glad I have had this opportunity of meeting you all who are engaged in the development of Indian fisheries and of addressing you a few words on what the country expects from those who are in a position by concentrated and determined efforts to speed up the production of fish in India and so increase the food resources of the nation. As you all know, the diet of the people in the large rice-eating areas of the country is deficient in important elements of healthy nutrition. This deficiency can easily be made up by an article of food like fish. Food shortages also, particularly in the rice areas, can be most cheaply remedied by the development of fish production. There is almost no item of human diet which could be procured at less cost than fish, and though only about fifty per cent of our population is fish-eating, fish as an item in a food production programme ought to receive in India much more attention and secure much more aid in the shape of money and man-power than has been extended to it so far. In a country like Japan, before the last war, the average daily consumption of fish per head was as much as four ounces. Since only 16 per cent of the total land area of Japan proper is available for agriculture, the Japanese have made up a part of their food deficit by developing their fish industry. The daily consumption of fish per head in India, as calculated a few years ago, could only be one-seventh of an ounce. In plain language this means that of this protective and vitamin-supplying item of food an Indian is able to take daily only 1/28th the quantity which his Japanese brother takes. When we note the latest available production figures, we realize equally vividly how backward we in India are in the matter of development of fisheries. Leaving aside Iceland, Newfoundland and Norway, which have special facilities and where the annual production per head ranges from 680 lb. to 6,223 lb. and taking only some of those countries to which India could be potentially comparable, we find that Japan produces 111 lb. per head per year, Canada 109 lb., Denmark 63 lb., United Kingdom 49 lb., Portugal 37 lb., Spain 37 lb., U.S.A. 35 lb., Germany 20 lb., France 20 lb., Soviet Union 18 lb., and India together with Iran and Burma 5 lb.

And yet there are great possibilities for fish development in our country. We have 3,200 miles of coast line, but we have touched a part of a narrow strip of 5 to 10 miles only within sea, whereas, if equipped properly, we could reach out to greater depths and distances, at least to the 100-fathom line. It has been estimated that in India we have been able to tap only 5 to 6 per cent of the entire fishable marine area.

We have however vast resources also inside our land borders. The inland fisheries of India include two sources of fish development, first the fresh water sources like rivers, canals, irrigation channels, lakes, tanks, ponds, etc. which hold water perennially or for the greater part of the year; and secondly they include those sources in the delta areas where the rivers meet the sea or the backwater areas where the sea runs into the land. It is a well-known fact that fresh water sources at present produce about one-third of the total production of fish in India, the sea-water sources producing the remaining two-thirds.

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*Opening speech of the Hon'ble Shri Jairamdas Daulatram, Minister for Food and Agriculture, Government of India, at the All-India Fisheries Conference held in Delhi on 27 September, 1948.

We have to develop both these sources of fish supply. There are some reasons why we may for some time concentrate more on developing the fresh water resources. Rivers, canals, irrigation channels, lakes, tanks, ponds and similar enclosed waters are scatttered throughout the country. Artificial ponds can also be constructed for fish culture. The important problems of distribution and transport easily solve themselves when items of food are produced not far from where the consumers live. China, Central Europe, the Balkans, the Islands of the Pacific, southern and south-western parts of the U.S.A. have extensive systems of farm ponds, and in the latter country artificial enclosures of water created as an incident to soil conservation programmes or irrigation projects have been converted into breeding farms of fish. The annual average yield of some species of fish from the farm ponds of the U.S.A. has been reported to be as high as 150 lb. per acre, which figure has sometimes risen to 400 lb. and even 1,000 lb., i.e. about 12 maunds per acre. These farm ponds are usually about an acre each. In a country like India where vast areas are under very heavy rainfall, a programme of fuller utilization of ponds, tanks and paddy fields for the development of fish culture ought to present less difficulties.

We speak frequently of the Indian diet being deficient in quantity and also in its vitamin content, and yet we have enormous resources for producing cheap supplementary and protective food which meets this deficiency at minimum cost. It has been said that 'measured by the labour involved fish is among the least costly of all protein foods. There are no fields to plough and cultivate, no seeds to sow, and no cattle to tend in order to reap a bountiful harvest'. But this truism can become true in the case of India only if the Government steps in much more actively and much more extensively and makes available to the producers of fish the advantages of research, cooperative organization and technical and financial aid. Fisheries are, as you know, a Provincial subject, but the necessities of the situation seem to place more and more responsibilities upon the Central Government in the matter of research, coordination and the piloting of largescale schemes of development of fisheries, both inland and marine. This is nothing unnatural or unusual. This has been the experience of all countries in Europe, America and the East. State, Provincial or Prefectural Governments in these countries have highly developed separate departments for fisheries, and yet a great deal of responsibility has had to be taken by the Federal or Central Governments in view of the important place of fish in the national diet or national trade.

The development programme of the inland resources of India as also the marine resources can yield results only when utmost effort is put forth in this direction both by the Central and the Provincial and State Governments and coordinated planning and cooperative execution become an immediate reality. I would consider this Conference amply successful if representatives of the Central and Provincial and State Governments could in the course of the next month chalk out a specific concrete programme of immediate action for developing our fresh water resources. Reliable surveys and statistical data are conspicuous by their absence. Technical and organizational efficiency has still to be achieved. Problems of preservation and marketing have yet to be tackled. Adequate technological research as the basis of appropriate action remains to be organized. These essential preliminaries for a proper development programme have to be satisfied before the needed results can issue. I would urge your special attention to this part of the fish production plans, and I will anxiously await the decisions you may arrive at for the fullest and earliest utilization of our fresh water resources.

This should, by no means, be interpreted that the fore-shore, off-shore and deep-sea fisheries are not to receive careful consideration. At present two-thirds of our fish production comes from brackish and marine sources but the development of marine fisheries will have to be a long-term measure. Though our fishing boats and the gear employed on them are, by no means, inefficient, the fishermen are at present unable to exploit waters beyond a few miles from the shore. This results in intensive fishing of our inshore waters and leaves the off-shore and deep waters untouched. While mechanization of the existing crafts would seem to be the solution for this problem, it appears equally necessary for us to experiment with suitable large-sized power fishing vessels, as has been done by practically all the advanced countries in the world. With this end in view, we have started an Experimental Fishing Station at Bombay. Its main objects are to chart our fishing grounds, to determine appropriate fishing seasons as also suitable nets and gear for our waters and to investigate other problems. The rich potentialities of our off-shore fisheries have not altogether escaped the notice of private enterprise. Some commercial concerns have also started fishing with power-propelled vessels in Bombay. Some other companies propose starting operations shortly round Travancore and in the Bay of Bengal.

How insignificant is our effort in regard to the proper development of the fisheries, whether marine or inland, becomes patent when one observes the widespread organization for the statistical, research, technological, training and marketing aspects of the fisheries industry, which has grown up in some of the more advanced countries. It would appear from a recent description of governmental effort in pre-war Japan published by our Fisheries Development Adviser that ‘training in fisheries was being conducted in 500 to 600 grammar schools. In addition, there were over 30 specialized schools for higher fishery courses in the 24 provincial units of Japan. There were two fishery colleges and in three of the seven Imperial Universities there were well-organized Fishery Faculties. There were six fishery laboratories sponsored by the Central Government and 112 provincial laboratories subsidized and supported by the Central Government. The laboratories and research stations carried out intensive work for developing new methods and processes of fishing, and conducted research on fish migration, fish population, fish reproduction and growth and other multifarious problems providing essential data for the conservation and development of the fisheries of the country. In addition to these government-sponsored research agencies, there were a fair number of laboratories and stations operated by private fishing companies. Practically every province along the sea coast had a fishing research vessel for carrying on investigations and for pilot fishing in this area. Japan had 135 up-to-date harbours built primarily for the fishing industry. The Japanese Fisheries Fleet before the war had 3,66,000 fishing vessels and employed 15 lakh persons’. This explains why a Japanese could procure 28 times the quantity of protective fish-food which an Indian can secure. The governmental efforts to aid the fish industry have been on an even vaster scale in some of the European and American countries, but I need not lengthen out a detailed description of those efforts. What can be achieved by developing our marine fisheries with modern equipment should be clear from a simple illustration that while in India varying estimates of the catch per man ranges from 2,800 lb. of sea fish to 5,800 lb., the catch in the United States with the help of trawlers is about 80,000 lb. per man per year and in some of the American fisheries centres the catch is as high as 2 lakh pounds. But as I said the development of marine fisheries is a long-term programme of which we can only make a right beginning for the moment. Its fuller potentialities as in the case of Japan and other countries also take us into wider regions. It is the fishing fleet and the fishing personnel which supply ultimately the means and men needed for sudden calls from the mercantile marine or the naval department of a country. These things are inter-related both ways. The mercantile marine as well as our naval vessels can in a very great measure also help to solve the problems of Indian fisheries without going very much out of their way by making themselves available for survey and operational purposes consistent with the requirements of their primary duties.

Last but not the least, I must refer to the social and economic condition of our fishermen. The prosperity and development of the fishing industry of India, as in fact of any country in the world, is naturally dependent on its fishermen. Fisheries in India are found dispersed throughout the entire length and breadth of the country and along our vast coastal belt numerous concentrations of fishermen are found in small villages inaccessible in most cases by road or rail. The fishermen are mostly ignorant, superstitious, highly conservative and chronically poor. They are wrongly considered to belong to a very low stratum of society and their profession is wrongly regarded as one of the meanest of all trades and professions. From the point of view of literacy, the fishing community is extremely backward, while owing to the lack of any training facilities the technical skill of the fishermen is confined to the restricted range of operations which they and their ancestors have been pursuing along traditional lines. They have generally no fishing rights, and are merely landless labourers working as primary producers, who have little to do with the marketing of their produce. Though some useful work for the uplift of the backward fishing community has been done in some parts of the country, notably in Madras and Bombay, very much more remains to be done in this direction. Until the social and economic status of our fishermen is materially raised and they become prosperous, contented, happy and self-respecting members of the community and through education and training their earning power is considerably increased, our fishing industry will never attain the heights which we are all aiming at.

You are aware that some months ago Dr G. L. K. Steven, Regional Representative of FAO for Fisheries in South East Asia, who had been touring various countries in this area, paid a short visit to India also to acquaint himself with the development of fisheries in this country. He has submitted a very informative report which is before you. The Government of India hope to consider and take action on his useful suggestions and your recommendations thereon at a very early date. I am glad that he is among us here today, and I am sure that he will be of material assistance in connection with the work of this Conference.

I have not thought it proper to take more of your time and deal with all the vital problems that are involved in a programme of full development of the fish resources of our country. I have no doubt that you who are specialists and have been dealing with various aspects of these problems will come to well-considered decisions governed by the one dominating factor of the need of immediate augmentation of food-stuffs in India thus enabling our country to be free and independent also in the vital matter of food. I entertain the earnest hope that you all representatives of the provinces and States will go back to your different areas pledged to make your very best effort to speed up the more urgent plans which may suit your local conditions. I trust each one of you will feel not that he is discharging his normal official duty, for which he is paid, but that he is one of the builders of a free and prosperous India whose aim can only be to serve the people by raising them to a higher level of economic and social life. That can be the only justification for our membership of the public services of India. May I now request you to begin the deliberations of your Conference.

Original Articles

ANIMAL HUSBANDRY RESEARCH*

By P. N. NANDA and H. K. LALL

FOR a proper appreciation of the work done by the Indian Council of Agricultural Research in the matter of animal husbandry research it is perhaps necessary to state very briefly the facilities that were available for this purpose and the work done prior to the establishment of the Council.

Modern organized research in animal husbandry commenced in 1890 with the opening of the Imperial Veterinary Research Institute to investigate the diseases of animals. As a result of the work of this Institute anti-rinderpest serum was first issued for use in the field in 1899, followed by the improved serum simultaneous method and finally by the cheap and efficacious attenuated goat-tissue vaccine, which has brought about the possibility of elimination of rinderpest from India within the field of practical consideration. In 1920 the Institute began to direct its attention to research for promoting the development and maintenance of the healthy animal by the study of nutrition. Individual research in animal breeding had been carried on at some places without a knowledge of the science of genetics and progress in this direction had naturally been very little.

Up to the establishment of the Indian Council of Agricultural Research, the position was that research on disease had been well-maintained, but that it was confined almost exclusively to the Institute and opportunities throughout the provinces were neglected. Research on nutrition had commenced at a few stations, but was inadequate in volume; research in breeding was carried out by empirical methods and no real progress was being made; research on sheep, goats and poultry was almost entirely neglected.

Although dairy research was the responsibility of the Imperial Dairy Expert who was appointed in 1920, when three military farms were handed over to him for that purpose, his work lay along the lines of breeding and cattle improvement. It was not until the Indian Council of Agricultural Research had come into being and the Indian Dairy Research Institute had been established at Bangalore that research strictly pertaining to dairying was commenced.

Animal diseases

The importance of obtaining provincial and State participation in research was early recognized and, as a first step, it was considered necessary to ascertain, as far as possible, what the actual diseases were which caused most loss and under what conditions they were encountered. For that purpose, Disease Investigation Officers were employed eventually in practically every province and major State, as well as Assistant Disease Investigation Officers, whose interest was either in poultry or sheep or goats. Since the first Disease Investigation Officer was posted in Hyderabad in 1930, a complete veterinary survey has been made, some of the diseases of unknown origin have been defined, their causes ascertained, and methods of overcoming them made available. Apart from that, these officers have been a very useful link between cattle-owners, provincial veterinary staff and research centres as a means of disseminating modern knowledge emanating from research centres. Their work was reviewed in 1945 when it was decided that, the survey having been finished, the officers should now turn their attention to research on a few specific

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* A review of the work done by the Indian Council of Agricultural Research.

problems of particular importance in their localities; subjects were allotted to each so as to avoid overlapping. It is anticipated that these trained officers will in the very near future be taken over by the Provincial Governments to form a nucleus of their research staff in animal health at the new stations to be opened. The nature of the benefit which has been derived from the work of the Disease Investigation Officers can be gauged from the following instances:

In Assam the presence of an insidious fatal disease called bovine pleuro-pneumonia has been discovered; a protective vaccine is available and as it is considered that the disease can be stamped out before it spreads to other provinces, a scheme to that end has been financed. As a result of field research carried out under a scheme financed by the Indian Council of Agricultural Research in the Central Provinces, the use of rinderpest vaccine has been further popularized. The Central Provinces Government have also been assisted in setting up quarantine stations and it has been possible to reduce by this method the number of outbreaks in 1945 by almost half. In Bengal, the production of rinderpest vaccine in a desiccated form has been perfected and applied. In the United Provinces, a simple method of vaccinating cattle by scarification is now under largescale test and promises to simplify and cheapen the process. In Orissa, the presence of tuberculosis among municipal cattle of Puri, which threatens the health of the neighbouring cattle, has been discovered, and a method of dealing with it devised. In Bihar, the cause of devastating sheep disease called 'pittoo' or 'gillar' has been ascertained and methods are available for dealing with it. In Hyderabad, an excess of fluorine was found in natural water in large areas which resulted in malnutrition of the cattle; means of reducing its effect have been devised. Instances of more advances could be given for practically every province and State.

Parasitism received early attention. The first Imperial Council of Agricultural Research Scheme was started in 1934 in the Punjab and other schemes followed in the United Provinces, Central Provinces and Madras. These have been mainly directed towards the elucidation of the life-history of common parasites so that methods of control can be devised. Progress has been slow but methods of effectively treating bowel parasites are known and could be applied to the mass. Liver-fluke is of ever-increasing importance as the irrigated area of the country expands and, with it, ravages caused by the parasite. Field research is proceeding concerning methods of control.

Protozoology was taken up in 1935 and an expert on the subject was posted to the Indian Veterinary Research Institute. Under his direction many new drugs produced elsewhere have been tried out in the experimental stage and passed on for field use, such as Plasmaquinine, Naganol and Antrypol. The studies have otherwise been of fundamental nature and show promise of producing practical results.

More recently, i.e. since 1938, attention has been given to diseases likely to arise as a result of intensive dairying such as have caused great havoc in other countries namely, tuberculosis, Johne's disease, contagious abortion and mastitis. As a result of a special survey on contagious abortion, the position in regard to this disease is now fairly well-known and the provinces mostly affected have taken advantage of the information obtained, and are framing measures to deal with the condition by the latest variety of vaccines and other methods. A new scheme which will cover in practice all India has been financed for the study of mastitis.

Animal nutrition

By 1931, the Indian Council of Agricultural Research started to finance schemes on this subject, first at Dacca and then in Madras, Bihar, the United Provinces, the Punjab, Assam and Bombay. At Dacca, the main work was directed towards the peculiarities of the nutritive value of the rice straw; the adverse effect upon calcium utilization and thus upon growth of the animal body was discovered; the modifications in feeding practice necessary to counteract it were indicated after work at the Indian Veterinary Research Institute had explained how the calcium was leached. At Coimbatore, among other things, the general nutrition of milch cattle was studied with special reference to their mineral requirements. A survey of the pastures of Madras with regard to their mineral content was also undertaken and the effect of soil treatment on crop composition was examined. Requirements of calcium and phosphorus for the milk cattle of Madras were discovered and the relation of deficiencies of these minerals in pasture with under-development of cattle was demonstrated. In Bihar a study of the chemical composition of common fodder and grasses was carried out. In the United Provinces, the nutritive value of these substances has been the subject of study and the relative values of common grass fodders and concentrates have been determined so that the cattle-owner can now be reliably advised what substitutes can be used when the usual cattle food is not available. In the Punjab, and at the Indian Veterinary Research Institute, the actual nutritional requirements of various classes of animals and for various forms of production have been determined, as well as the nutritive value of most of the common fodders and some special concentrates. In Assam, a study has been made of the value of various grasses and work is now directed to the discovery of the best means of fodder conservation. It has been shown that rice straw is greatly improved when washed simply with water, and that procedure is in the process of trial under field conditions. The nutritive value of leaf fodder as well as grasses of the United Provinces has also formed the subject of special research. A study of the nutritive value of *vanaspati* and *ghee* suggested that if the former was consumed in a diet on the borderline of vitamin and calcium requirements, the effect might be decidedly adverse. An experiment just completed in Malabar showed decisively that climate by itself plays a comparatively smaller part in the defective growth and development of animals when compared to an unbalanced or insufficient diet and to the effects of parasitism. Two experiments have been carried out to see if there was any foundation for the objection of farmers to feed fuzzy cotton in the Punjab and groundnut cake in Baroda. It was shown that both could be fed with impunity and profit. In Madras, a laboratory in the Medical College has been financed to confirm or refute the commonly held opinion concerning the danger of poisoning by certain common plants and to discover the value of indigenous medicinal plants and drugs.

The following practical results have been achieved in nutritional research:

1. The enhancement of the feeding value of rice straw by washing.
2. The use of *munj* and *kans* grass by ensilage.
3. The use of fish-meal, bone-meal and other animal by-products as a valuable addition to the supply of protein and concentrates.
4. The advantage of rotational and controlled grazing.
5. The power of properly evaluating cattle foods.
6. The method of saving foods which are now being used extravagantly, e.g. in city milk production.
7. The ability to estimate, though still very imperfectly, the country's feeding resources and requirements.

Breeding

Cattle breeding under methods not thoroughly understood was being conducted at Government Farms in nearly every province and State when the Indian Council of Agricultural Research came into existence. This improvement of established herds by what was thought to be the method of breeding but which was probably to a large extent due to improved management was being undertaken with considerable success. The milking capacity of Indian dairy breeds of cattle has been gauged but development through progeny testing has only lately been put in hand. Cross breeding with Fresiens has produced a high yielding indigenous cow which can be maintained under protected conditions.

Goat breeding in the United Provinces in 1932 formed the first scheme of modern research in breeding other animals.

Sheep breeding in Bombay and the Punjab was initiated in 1935-36 and in Madras in the following year. During this time, the lack of trained animal geneticist had become very apparent and a student was sent abroad in 1938 and encouragement was given in the training of others. During the next year, sheep breeding schemes involving crossing with foreign breeds was started in Mysore and Kashmir, and the first wool laboratory was instituted in Bombay. In this year also cattle herd book registration was commenced so that reliable records of the pedigree of the best stock in breeds of all-India importance should be available. Neither in India nor elsewhere, had a method of measuring the quality of the animals' ability for work been evolved. A scheme at Hissar was started in 1940 under a geneticist to study the problem and another was commenced in 1942, at Allahabad. In 1940 investigation in artificial insemination was commenced at the Indian Veterinary Research Institute, and for large field experimental application, four sub-stations were opened in 1943. The increased use of these stations by the public indicates success. Again in 1940, it was considered that by using proper breeding methods, it would be possible to encourage mill production of cows belonging to draught breeds without impairing the quality of bullocks, and work towards that end was started in Madras.

In these years other schemes of scientific breeding of sheep and goats had been initiated. Among them was one for the production of Karakul pelts, in the North-West Frontier Province and for evolving a breed of goats by the use of pure-bred Angoras which would produce mohair. New sheep breeding schemes for the improvement of wool have been financed each year up to date, but in 1942, one of a different type was opened in the North-West Frontier Province. Its aim was to demonstrate the value of improved shearing, washing and grading of fleece. In 1944, a similar scheme was started in Ajmer. Milk recording or Cattle Improvement Schemes, as they are now called, had been started in the villages of Travancore, Bombay, Sind, the United Provinces, the Punjab and Ajmer, the ultimate object being to turn selected villages into subsidiary cattle farms, and the immediate object being to encourage villagers to increase their milk supply by controlled breeding from milk-recorded stock with better feeding and management.

Poultry breeding schemes commenced in Bombay in 1935 with the parallel study of improvement by selection and cross-breeding. In 1940, the Indian Veterinary Research Institute initiated a poultry scheme in certain villages to see what the result of introducing foreign blood would be and to supplement the breeding experiments on foreign birds which had been extensively carried out at the Institute. Work in Bengal, Central Provinces, Madras and Bombay was taken up later on similar lines.

The main immediate advantages accruing to the farmer from research in breeding are:

1. The supply of improved sires and reliable breeding stock.
2. The means of multiplying their usefulness by artificial insemination.
3. The means of improving the quality and quantity of wool by (a) selective breeding in the plains, and (b) cross-breeding with Merinos in the uplands.
4. The means of increasing the milk supply from goats by upgrading with superior indigenous breeds.

Dairying

In 1936, at the suggestion of His Excellency the Viceroy, a village enquiry regarding the cattle and the production and consumption of milk in seven breeding tracts was undertaken and the work directed attention to the needs of the milk market. As a result, research was focussed on the means of detecting adulteration in milk and *ghee*, and as a corollary, the study of the detailed composition of Indian milk was taken in hand in a scheme started in 1936. Work on the vitamin content and minerals was pursued a little later. The bacteriological content of milk was taken up in 1942. In 1944, largescale investigations were commenced to obtain sufficient data in each province for the re-examination of the legal presumptive standards of market milk to be made with a view to removing defects and injustices.

In 1940, the methods of detecting adulteration in *ghee* was started. The freezing-point test for milk quality was tried out in 1941, and again in 1943; simplified tests for the estimation of fat content were devised in 1942-43. A scheme in the same year was directed towards the detection of the mixture of skim milk powder in tinned milk. The use of sesame as a detector of adulteration of *ghee* with *vanaspati* was investigated, as well as methods of distinctively colouring *vanaspati*. In 1946, the Resazurin test for the cleanliness of milk was tried out under Indian conditions. Some years previously the housing requirements of Indian dairy cattle in relation to milk production and milk quality were determined and the work of designing a simplified and improved *ghee* boiler and refiner was started and successfully completed later. In 1941, a scheme to promote *ghee* production and improve the milk qualities of the cattle of the graziers in the Jhallar District of the Central Provinces was financed, and in the same year money was allotted for the study of the economics of handling milk between village producers and town consumers. A survey of market *ghee* was commenced in 1943, and an investigation was undertaken to compare the nutritive values of *ghee* and *vanaspati*. Work was also in progress this year towards the discovery of a suitable vegetable rennet.

In 1945, the possibilities of transporting milk at a high temperature were investigated and research was started towards devising a simple method of utilizing surplus whey for casein manufacture in Bengal villages. A study of the current methods of making *ghee* and casein has been carried out with a view to finding the most practical way of improving them.

The chief results of practical importance so far obtained are :

(1) The production of vegetable rennet.

(2) Means of manufacturing edible casein and lactose on a cottage industry basis.

(3) Manufacture of rennet casein under village conditions.

(4) Method of neutralizing high acidity of *ghee* on common lines.

(5) Manufacture of a simplified and improved *ghee*-boiler and village utensil steamer.

(6) Simplified method of testing fat in milk.

(7) Standardizing sesame oil test for detecting adulteration of *ghee* under Indian conditions.

Fish

Fish research has been carried on over a long period in more or less small isolated units and although its quality has been good, its quantity has been deplorably small and in no manner corresponding to what the modern situation demands. There has been practically no coordination or overall policy, but the immensity of the field has ensured that needless repetition or overlapping has been avoided. Schemes for fish research were not sponsored by the Imperial Council of Agricultural Research until 1936, when the study of some fresh water fishes at the University of Calcutta was financed, the chief scheme being to collect basic knowledge concerning edible Bengal fishes. In 1940, another scheme was started in Madras whose aim was also the study of inland fishes of importance with a view to devising means of extending their cultivation. The Madras Government opened an Inland Fishery Research Station at Chetput to augment the same. The best method of preserving dead fish was studied in Baroda in 1942, while in 1943, the study of plankton fish eggs and larvae of salt water fish was taken up in Bombay and Madras. Work was commenced in 1943 towards devising improved methods of preserving fish for food in Bengal and in 1944, work was started in the Collair and Pulicat lakes, Madras, with a view to finding better methods for manufacturing dried prawns.

Apiculture

Organized research is being done mainly at the Jeolikote Station in the United Provinces, and prior to partition of the country at the Central Bee Research Station (opened three years ago at Lyallpur Apiary which has been in existence since 1934) and by entomologists at various provincial agricultural centres, such as the Institute at Coimbatore. Work has been mostly directed towards obtaining knowledge of the normal habits of indigenous varieties of bees with a view to their domestication or exploitation in the wild state, the important source of nectar and pollen, control of bee parasites, and the manufacture of cheap appliances. The question of organizing agricultural research on a country-wide scale is engaging the attention of the Council.

Hides and skins

Research directed towards the prevention of damage to hides and skins was started in 1940 when a largescale field experiment to control ticks and warble flies was put in hand in the Punjab, and well-known methods were applied to typical villages in Bombay ; work was successful and is now being taken up as a developmental plan in that province, while Bengal and Central Provinces have asked that trials on similar lines should be made in their villages. The demand for an effective cheap skin dressing which the villager can himself apply to his cattle was met in 1946, and an insect fatally parasitic to ticks, which it is hoped further research will show us the means of using, has been found.

General

It will be seen from the foregoing narrative that the Council has given a great incentive to animal husbandry research throughout the country, and in order to meet the demand for more specialists in this branch of science, the Council has stressed the importance of improving veterinary education imparted in the country. As a result of the Council's efforts, the standard of education in all the Veterinary Colleges in India has been or is being raised to a degree course and the colleges have been affiliated to the local Universities.

In order to bring the veterinary organization in India in line with those in other parts of the world, the Council advocated the policy that all matters, viz. breeding, feeding, disease control and management connected with livestock should be unified under one department styled 'Animal Husbandry Department'. It is gratifying to note that most of the provinces have accepted this recommendation and reorganized their departments to suit modern conditions.

At the Centre, the Council has been acting as the Adviser to the Government of India in all matters connected with livestock improvement. Schemes for the establishment of Central Cattle Breeding Farms, Central Research Institutes for animal husbandry products and a Central Animal Husbandry College were drawn up by the Secretariat of the Council.

The Council drew up a model Bill for the control of contagious diseases and model rules for meat inspection and for the prevention of adulteration of dairy products for adoption by the provinces and constituent States of the Council.

On the animal husbandry side of the Council, more than 100 schemes are in progress and the cumulative effect of all this work will be reflected in years to come in the agricultural economy of the country.

SKIM MILK AS HUMAN FOOD

HOW the fullest use can be made of skim milk as a human food will be investigated at laboratories and modern pilot plant to be erected at Highett, Victoria. Council for Scientific and Industrial Research is dissatisfied with the present practice of feeding to stock much of the high quality protein, lactose, mineral salts and vitamins that are in skim milk while much of the world is ill-fed.

The Dairy Products' Research Section hopes to develop a means of using skim milk solids and skim milk as a human food.

In Sydney experts are already investigating the use of skim milk solids in bread, and are cooperating with the British Ministry of Food in developing the German 'milei' or war-time egg substitutes.

'Milei' produces some of the more important physical properties of whole egg and egg albumin, especially in baking.

The section has already developed a sweet spread for bread out of skim milk solids. Experts suggest it has a commercial scope as cake filling.—*Australian Agricultural Newsletter*, No. AGN/222.

PLANT PROTECTION SERVICE IN THE UNITED PROVINCES

By K. B. LAL

THE Government of the United Provinces are the first among Provincial and State Governments in India to establish a Plant Protection Service on a planned basis. This Service, which is meant to control agricultural pests as well as diseases, started functioning in August 1947. A Plant Protection Service is a new development, if not exactly a new conception, in India. The working of such a Service in the United Provinces has revealed many problems of technique, organization and policy. An account of its beginnings should, therefore, be of general interest, specially as some other provinces and States may be contemplating the establishment of similar Services in their areas.

Objects

The Plant Protection Service, United Provinces, has been started with the following main objects :

1. To organize largescale control operations against crop and other pests and diseases in different areas of the province.
2. To maintain a regular watch and ward service for the detection of pest and disease attacks on crops, fruit trees and in grain and potato storage godowns in early stages with a view to simplifying future measures of control against them and ensuring the latter timely and promptly.
3. To prevent the entry and spread of agricultural pests and diseases within the province.
4. To demonstrate to the satisfaction of the cultivators the effectiveness of certain measures to control pests and diseases and to impress upon them the advantages accruing out of the control measures.
5. To render practical assistance to farmers, fruit-growers and others to fight pests and diseases and thus to raise more and better crops and to save their stored crop produce from damage by pests and diseases.

Principles and policies

The Plant Protection Service, United Provinces, is to be governed by the following broad principles and policies :

1. The Service is not to engage in any basic research on pests and diseases or on the methods of controlling them, these aspects of work being left, as hitherto, to the Research Entomologists and Plant Pathologists. The Service, however, will be concerned with finding out the relative merits of two or more control measures against the same pest or disease as applied in the field, with the assessment of the effects of such measures and the calculation of their costs and the evaluation of both against the expected or actual benefits arising from them.
2. The Service will undertake the control of only those pests and diseases against which definite measures are known or have clear and reasonable chances of success.
3. In its work the Service will collaborate with all organizations interested in crop improvements. It will initiate and organize work, provide technical assistance, materials and equipment and demonstrate the results to whomsoever they may concern but would depend for its complete success on the active and willing cooperation of the agricultural and other government staff and of the cultivators.
4. For the first two years at least all costs of control operations against pests and diseases would be borne by the Government.
5. For the first two years at least, propaganda and persuasion, rather than compulsion, legislative or executive, would be the means by which the Service would attempt to conduct its work in the fields of any cultivators who may raise objections to such work.
6. The Government of the United Provinces would be under no legal liability to necessarily

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control every body's pests and diseases everywhere.

7. The Government of the United Provinces would not necessarily accept liability for compensation for damage caused to crops, etc. in the course of control operations.

Staff and expenditure

The Plant Protection Service in the United Provinces is being run as a scheme of the Provincial Government for a period of five years in the first instance. Its staff, equipment and facilities are to increase progressively during the first three years at the end of which, it is expected, the Service would be running in full swing. This has been done to ensure the gradual collection of materials, equipment and also personnel and to enable the staff to acquire much-needed training and experience. The following Table gives the strength of the Staff in the Service :

Staff	1947–48	1948–49	1949–50
Senior Plant Protection Officer (Entomologist) (Gazetted) (Rs. 500-1,200)	Appointment under the consideration of the Government.		
Junior Plant Protection Officer (Mycologist) (Gazetted) (Rs. 250-850)	1	1	1
Senior Plant Protection Assistant (Rs. 200-350)	3	6	6
Junior Plant Protection Assistant (Rs. 120-250)	12	26	49
Agricultural Supervisors (Rs. 75-120) ...	15	32	55
Field Attendants (Rs.25-35)	36	78	147
Ministerial staff* ...	3	5	5
Inferior staff (Rs. 25-35)...	4	5	5
Total staff ...	74	153	268

* The ministerial staff includes a gazetted Accounts Officer.

During 1947-48, the total expenditure incurred under the Plant Protection Service was Rs. 65,938, of which Rs. 17,338 were spent in the salaries of staff and the remaining Rs. 48,600 in travelling and other allowances and on control operations which included costs of dusting and spraying machines, costs of insecticides, fungicides and other materials and charges on labour, transport, etc. The total expenditure under the Service during 1948-49 and 1949-50 is expected to be in the neighbourhood of 2½ and 4 lacs of rupees respectively.

Organization

The Plant Protection Service, United Provinces, has been placed under the charge of the Entomologist to Government, United Provinces, with its main headquarters at Kanpur. In addition, it is to have six plant protection centres, each located preferably at the headquarters of a Deputy Director of Agriculture. Three of these centres have already been established at Ranikhet-Almora, Lucknow and Meerut, respectively, and a fourth one at Gorakhpur will start functioning very shortly. Two more centres may be opened at Jhansi and at Partabgarh or Banaras, respectively. Each of these centres is to be self-sufficient, as far as possible, with materials and equipment and each is to look after the districts falling within its jurisdiction. Each centre is to be under the charge of a Senior Plant Protection Assistant, who will in turn have as many Junior Plant Protection Assistants, an equal or more number of Agricultural Supervisors and twice or thrice as many Field Attendants as there may be districts within his centre. Since the Service is to operate for the control of both pests and diseases, the recruitment of Assistants has been on the basis of two Entomologists for every one Mycologist, but in actual practice every Assistant is expected to be familiar with both pests and diseases, and may be assigned duties without much consideration of initial qualifications.

Work against pests and diseases

The Plant Protection Service started with control operations against the Pyrilla pest of sugarcane in Meerut and Muzaffarnagar Districts during September, October and November 1947. Of over 460 acres, found to be badly affected by the pest, just over 288 acres of cane crops were dusted with Gammexane D.025 and about 14 acres sprayed with D.D.T. Almost simultaneously, campaigns against the red-rot disease of sugarcane were conducted in nine districts of central and eastern United Provinces. A total area of over 6,627 acres under Co. 312 and a thin variety, locally known as *Mamchua*, was observed to be

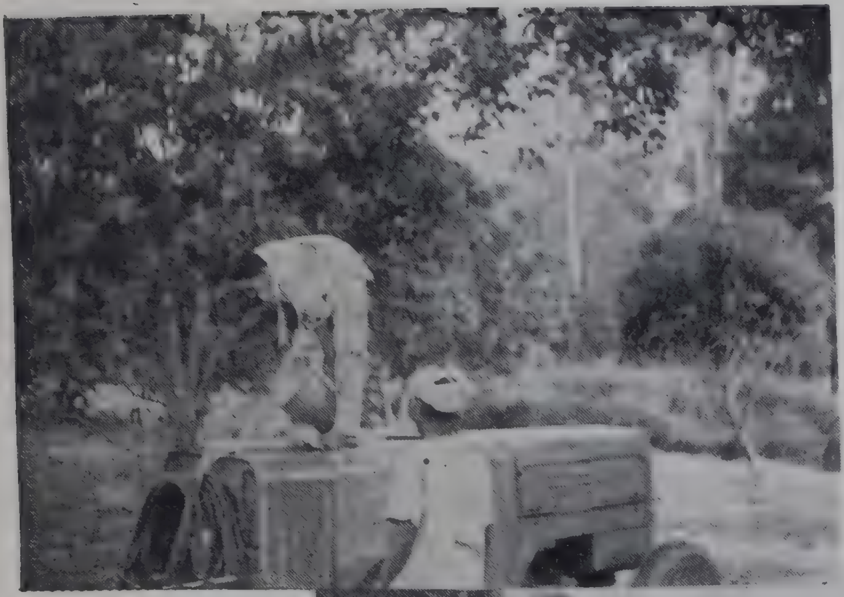


FIG. 1. A power spraying machine being filled up with insecticide for spraying against mango hoppers.

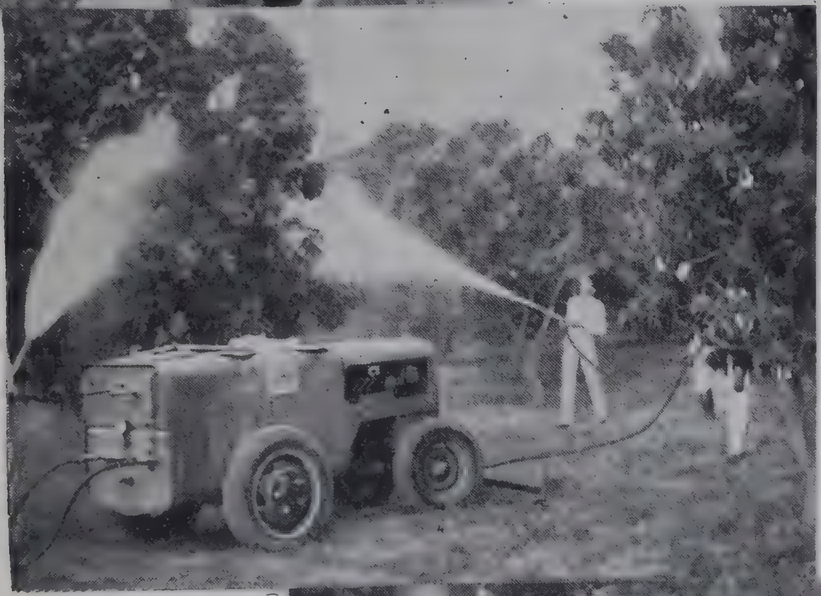
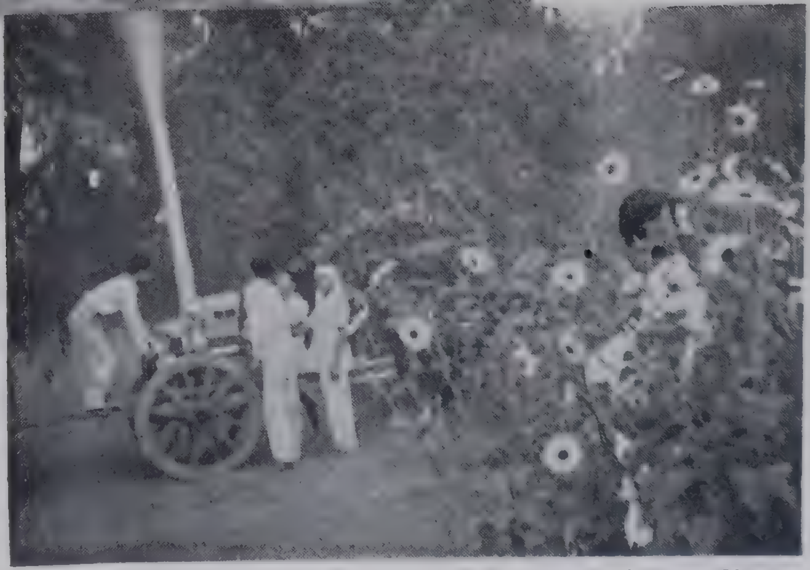


FIG. 2. A power spraying machine in action, with its two spray nozzles at the ends of long hose pipes, directed on to a mango tree.

FIG. 3. A power-dusting machine, mounted on an ordinary country cart for easy mobility, throwing a cloud of dust on a mango tree for controlling powdery mildew.



(*Photos by Shri Ibne Ali.*)

PLATE 31

affected by this disease. Of this area over 6,415 acres were successfully 'rogued' and another about 214 acres were allowed to be quickly harvested in the beginning of the season before any serious damage could be done. Alongside these operations, propoganda was carried out to educate the growers in the measures to be adopted against the red-rot disease. As a concrete step in this direction, cane crops at 35 centres in seven districts were examined during the first three months of 1948 and an area of about 2,299 acres under cane, with an estimated yield of 10,80,676 md. was certified free from the disease and recommended for use for planting purposes. The entire work on sugarcane pests and diseases was conducted in close collaboration with the Cane Development Department, United Provinces.

During March to May 1948, spraying and dusting operations were conducted in Lucknow District against the mango hopper and citrus pyrilla pests and the powdery mildew disease of mango leaves. Forty citrus and about 700 mango trees were successfully sprayed with tobacco decoction and a D.D.T. emulsion, respectively, while eight big trees and a large number of seedlings of mango were effectively dusted with sulphur against the powdery mildew disease. It must be remarked in this connection that for the first time in the history of Indian agriculture, power spraying and dusting machines went into action against fruit pests and diseases.

Other activities under the Plant Protection Service included a survey of the pests and diseases of fruit trees in 131 orchards of Nainital and Almora Districts during February and March 1948; control operations against gram cutworms and the 'ear cockle' disease of wheat in Meerut District in March 1948; dustings against the red pumpkin beetle in Lucknow District and operations against field rats in certain areas in Lucknow and Kanpur Districts.

Programme of work

The Service had a programme of work to start with but, due to various reasons, some parts of this programme could not be carried out, e.g. that relating to the control of the pests and diseases of temperate fruit trees; while some others, e.g. the control of the mango hoppers, could not be carried out as extensively as had been originally proposed. It has also not been possible yet to undertake the treatment of some *kharif* and *rabi* seeds with a chemical called Agrosan GN as a preventive measure against various smut diseases, which had been originally decided upon on the recommendation of the Plant Protection Adviser to the Government of India. It must be remembered, however, that in plant protection work the best laid schemes may go astray and pests and diseases may appear suddenly in unsuspected areas, upsetting all previous calculations and necessitating the immediate adoption of control measures in new directions and areas. To this extent, therefore, the programme of any Plant Protection Service anywhere has to be very fluid and easily adjustable. No detailed plans have yet been prepared for the prevention of the entry and spread of pests and diseases into the province, the fumigation of plants and plant materials being exported outside, for the routine examination of grain and potato storage godowns and for a regular system of assistance to cultivators for fighting pests and diseases. These, however, will have to come soon to make the Plant Protection Service full and efficient.

Some problems

A major technical problem for the Plant Protection Service has been to adjust the methods of control recommended by Research Entomologists and Plant Pathologists to the conditions and requirements of field applications. Some measures (e.g. dusting against red pumpkin beetles), well-known to be effective on a small scale, have turned out to be inadequate on a large scale. In other cases, dosages and the precise methods of preparation of insecticides and fungicides on huge scales have had to be quickly re-examined and suitably adapted to requirements. The demonstration of the efficiency of a control measure has been another problem. A Plant Protection Officer may be personally convinced of the value of a measure but that is not enough unless he carries his conviction home to others also, not merely high government authorities but also the cultivator and the fruit-grower who must be the ultimate judges of what has been done on their farms and in their gardens. One of the most serious difficulties that the Service has had to contend with has been the problem of transport; how to move machines and materials to remote villages at a moment's notice. Pests and diseases cannot hold up their damage till arrangements are made to deal with them. Rapid mobility not only of equipment but also of staff must, therefore, be one of the main characteristics of a Plant Protection Service. In its work there must be no holidays and no respite till a certain operation is over. Active collaboration of the various government organizations and of the people is yet another major condition of success. Some times indifference results from a want of appreciation of the aims and functions of a Plant Protection Service. These must be put constantly and clearly before all concerned. Above all, the need for close and constant cooperation between the Plant Protection Service and the Research Entomologist and Plant Pathologist cannot be too strongly emphasized, the former throwing out problems and the latter passing on their solutions for application in the field. A very refreshing instance of such cooperation occurred recently in this province when, on the non-availability of fish-oil-rosin soap, several promising insecticides had to be quickly tested for the control of the mango-hopper pest.

General

It has been estimated that the annual losses caused to various crops and crop produce in the United Provinces by insect pests alone may be fifty crores of rupees. If the Plant Protection Service succeeds in preventing even one-hundredth part of this loss—it must do very much more—it must amply repay the expenditure of a few odd lacs of rupees on it. In our rapidly developing agriculture along scientific lines, it is not enough to use the best seeds, to apply appropriate manures and fertilizers, to arrange for timely and adequate irrigations, to employ tractors and other modern implements in cultivation but also *to control pests and diseases* properly and promptly. Then lone can we reap the best harvests.

Acknowledgments

The thanks of the Plant Protection Service are due to the Plant Protection Adivser to the Government of India for advice and ready help of various kinds, including the loan of a power-spraying machine and to the Publicity Officer, Department of Agriculture, United Provinces, for his personally taking the photographs reproduced in this article. No thanks would be adequate to the present Government of the United Provinces for the boldness and imagination with which they embarked on the project of Plant Protection Service.

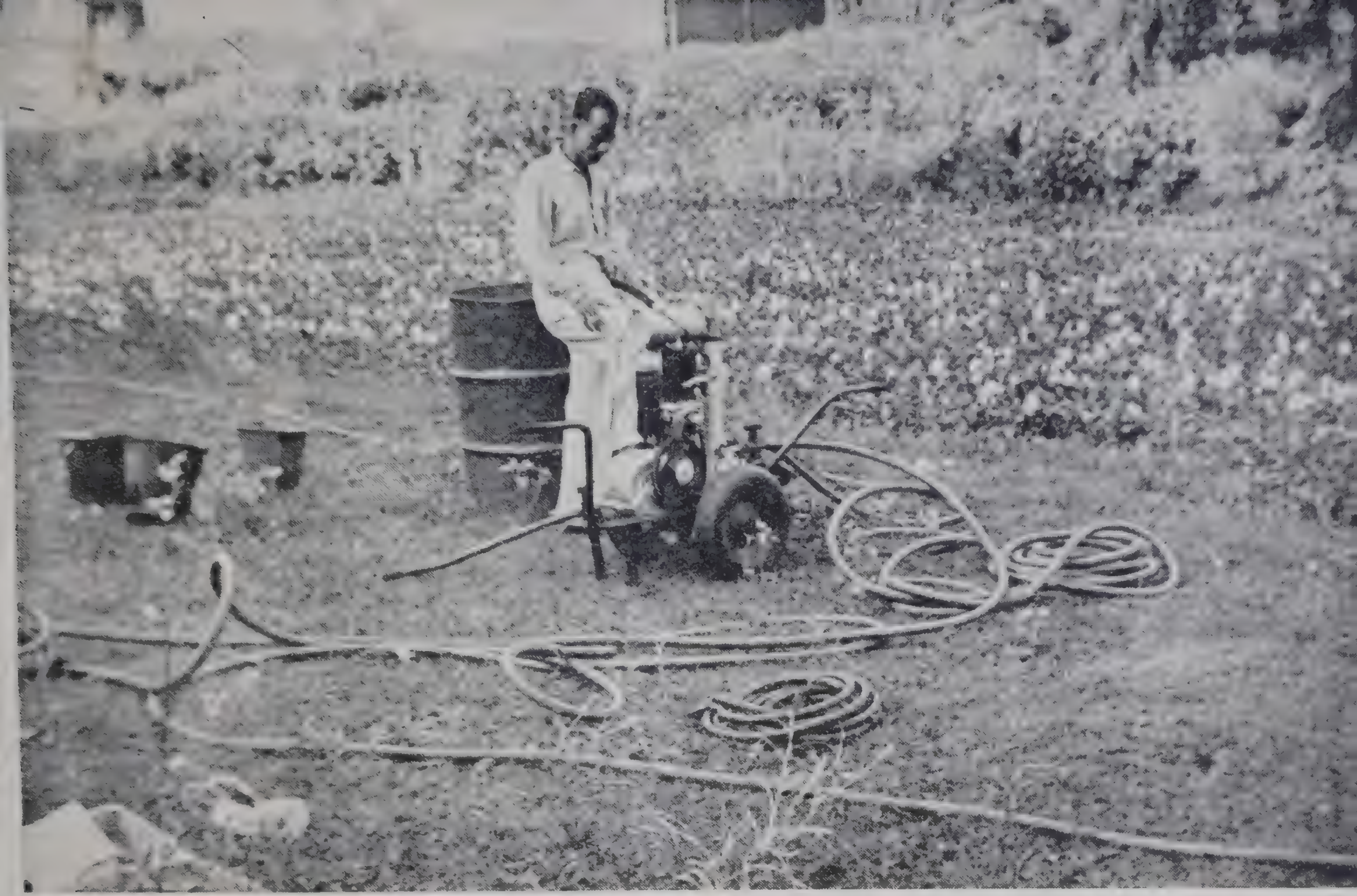
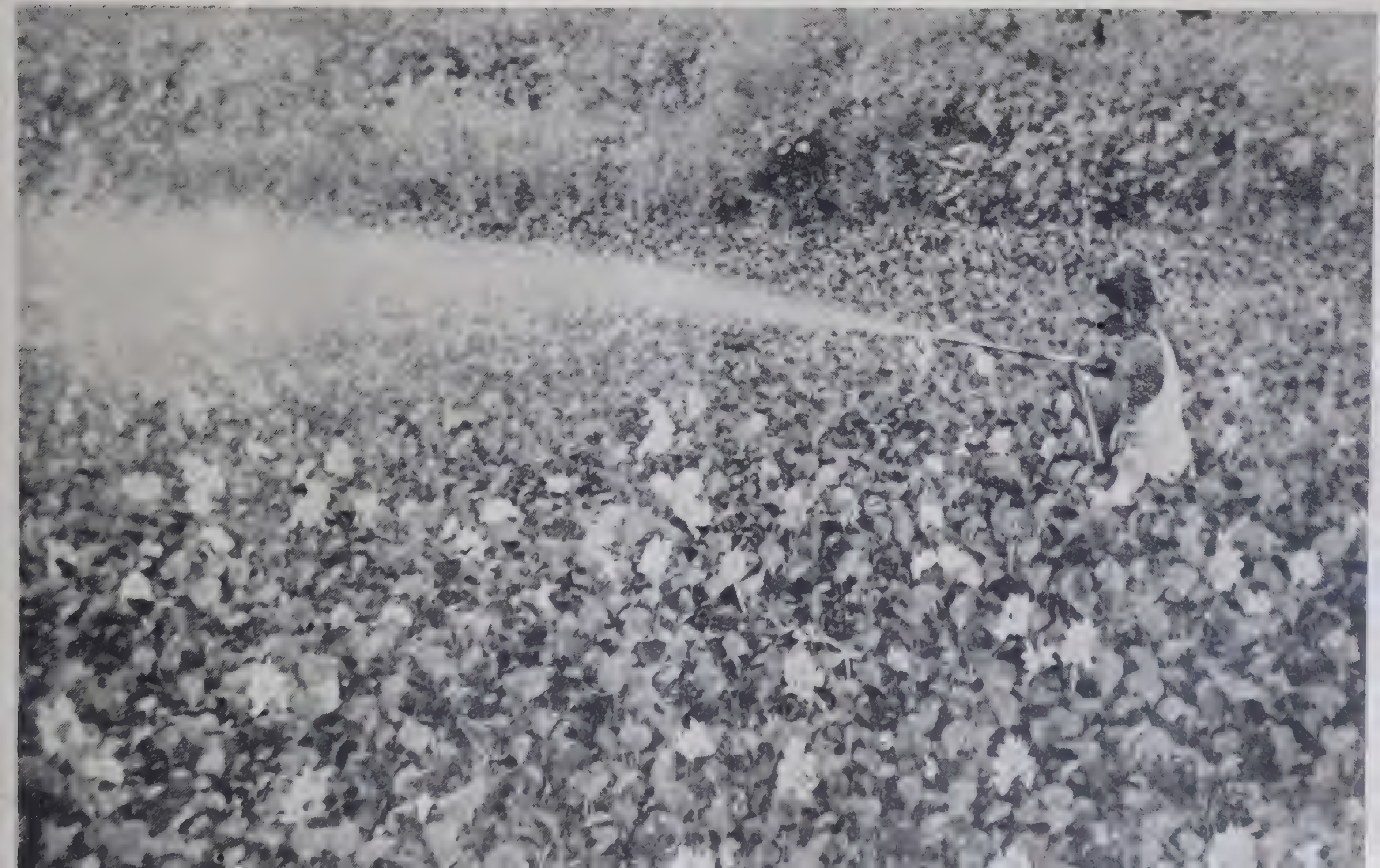


FIG. 1. (above). $1\frac{1}{2}$ h. p. portable spray pump in use spraying water-hyacinth with Methoxone.

FIG. 2. (below). Spraying water-hyacinth with the aid of an adjustable spray gun giving a 25 ft. jet spray.



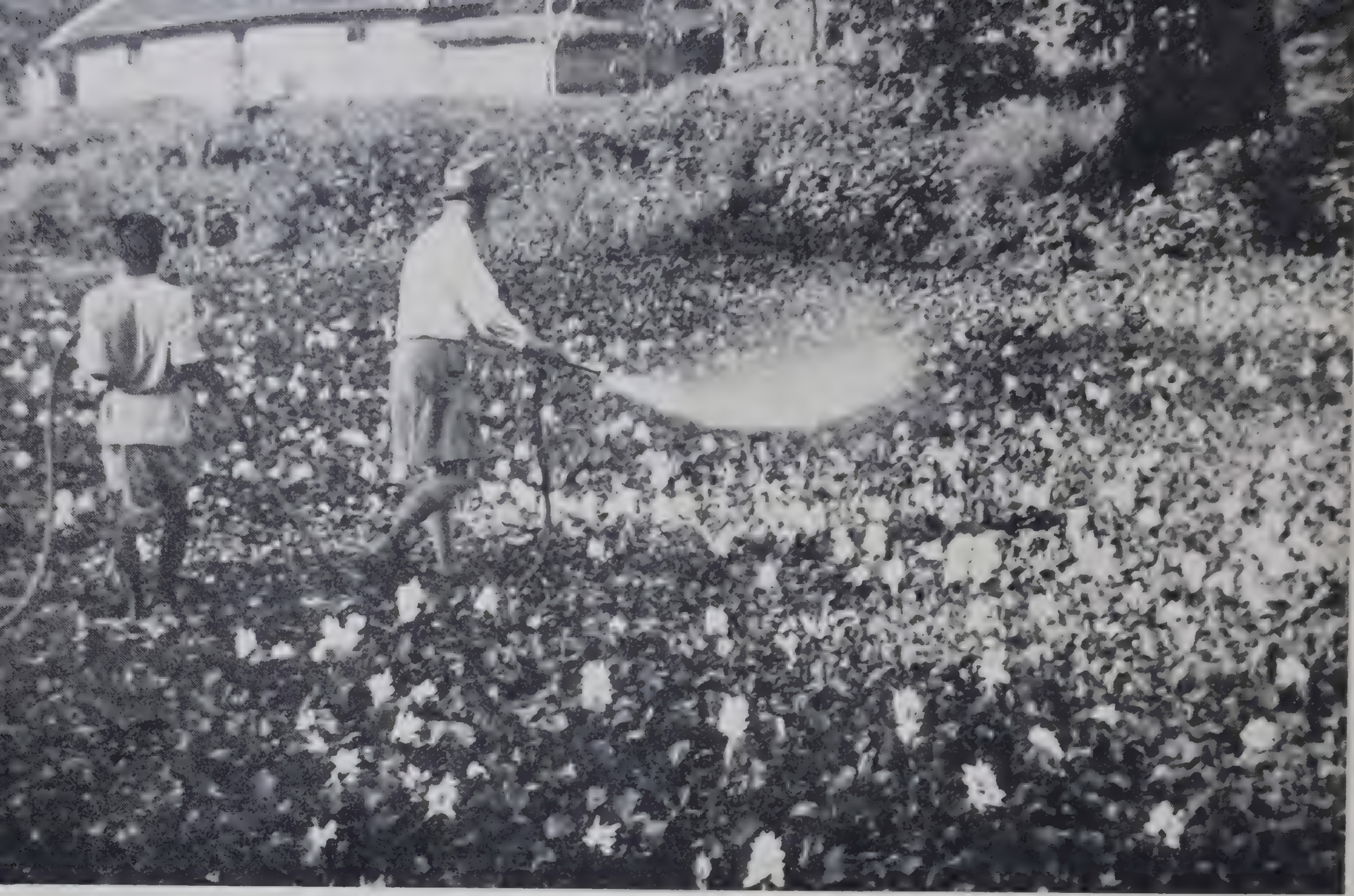
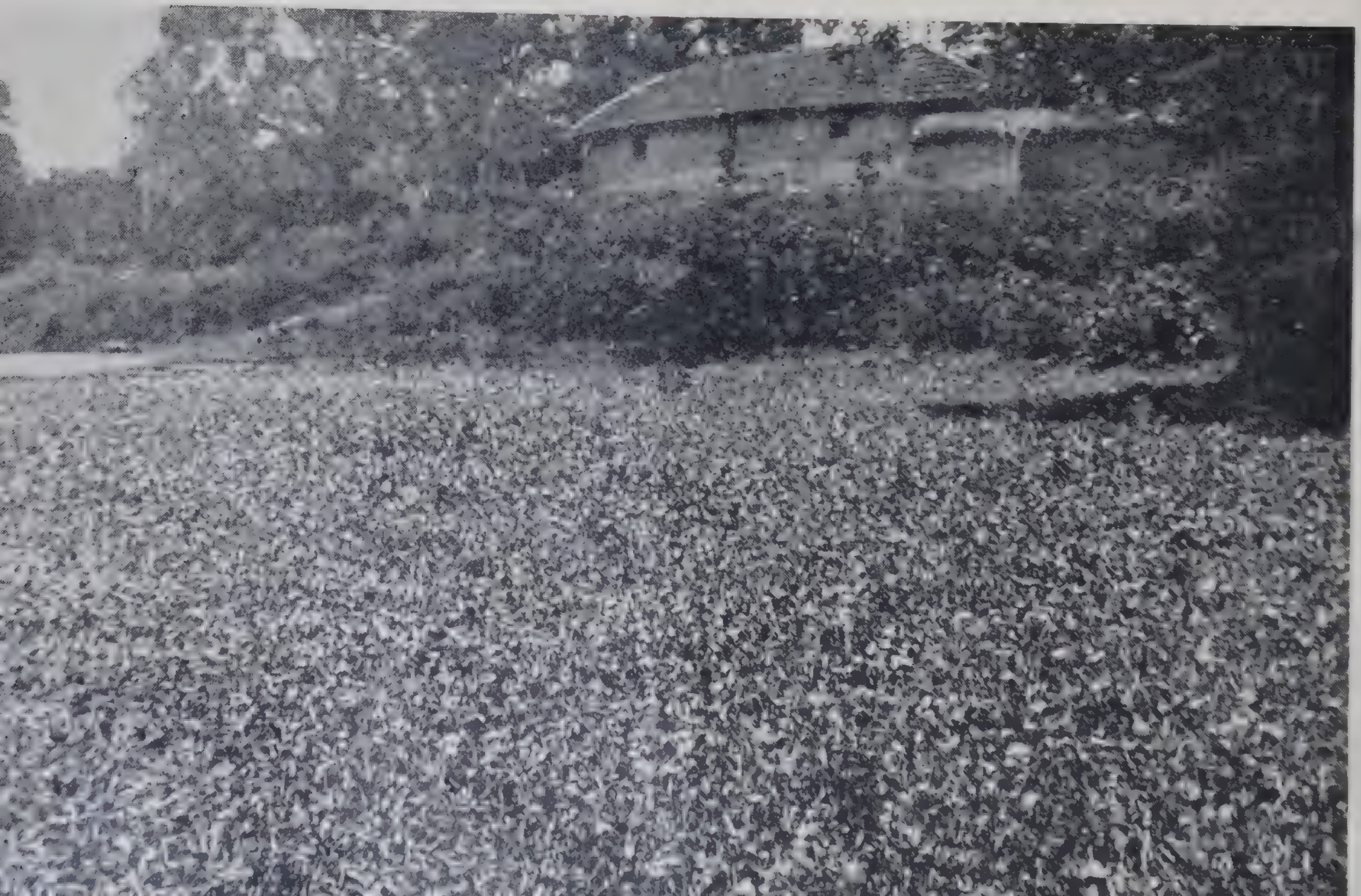


FIG. 3. (above). Spraying water-hyacinth with the adjustable spray gun set to a mist-like spray.

FIG. 4. (below). The water-hyacinth shown in Fig. 3 eleven days after spraying with 1 lb. of Methoxone per acre in 80 gallons of water.



CHEMICAL CONTROL OF WEEDS

By G. WATTS PADWICK

THE chemical control of weeds has come much to the forefront in recent years, due chiefly to rapid developments in plant physiological research. Chemicals have been used for killing weeds for many years, but not extensively until the last decade. Arsenical compounds were the most widely used, but they have two drawbacks; firstly, they are very poisonous to livestock and secondly, they are non-selective, killing crops as well as weeds. Consequently, they were useful mainly on roadsides, railway embankments, and very bad patches of perennial weeds in fields. Phenolic compounds, coal tar derivatives found as waste products of the coal tar distillation industries, etc. have been, and still are, used as weed-killers. They, likewise, are non-selective. So is sodium chlorate, a quite effective weed-killer of the soil sterilizer type. Copper salts, dilute sulphuric acid and dinitro-ortho-eresol, however, have a selective action, killing broad-leaved weeds like mustard in cereal crops. Then there are oils, some of the lighter of which proved selective in their action. For example, certain fractions of kerosene oil readily kill the broad-leaved weeds in carrot crops, leaving the carrots unharmed.

Plant hormones

The discovery which excited the agricultural world was that of the selective weed-killers of the 'hormone' type. For many years plant physiologists had studied 'plant hormones', substances so-called because, like the hormones of animals, they were chemicals produced by the plants themselves, and, although needed in only very small quantities, had a profound effect in regulating the growth of the plants and the development of different types of tissue. During the second world war, investigators in England and U.S.A., working independently, discovered that if these 'hormones', or closely related chemical substances, were applied to the plants in sufficient quantities, they caused marked abnormalities, which were usually followed by the death of the affected tissues, and frequently of the entire plants. In other words, they were found to have the properties of weed-killers. However, they did not affect all plants in like manner, and whereas some plants were highly susceptible to small dosages, others required much larger amounts, and sometimes resisted quite excessive applications.

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Methoxone and chloroxone

British investigators, studying a number of synthetic compounds closely related to the 'plant hormones', found that certain of these compounds had plant-killing (phytocidal) properties. The selective action of naphthylacetic acid was discovered in Britain in 1940, but, owing to wartime regulations, publication of the findings was delayed until 1945. High in the list of effective materials stood 4-chloro-2-methylphenoxyacetic acid (Methoxone') and 2,4-dichlorophenoxyacetic acid (Chloroxone). A great deal of information is available on the behaviour of both these chemicals. Although of the same general level of effectiveness, they possess certain differences of practical importance. Methoxone appears to be more persistent in neutral and slightly acid soils than Chloroxone, while the latter more readily produces deformative effects on plants. Again, the sodium salt (a common form in which supplied commercially) is more soluble in the case of Methoxone than Chloroxone.

Differing formulations

Chloroxone and Methoxone can be formulated as acids, salts, esters or amines. The pure acids are nearly insoluble in water, and, therefore, for agricultural uses the sodium salts, amine salts and esters are preferred. Of these, in general, the esters are most effective on very resistant plants, such as woody species, and under unfavourable conditions tend to act more quickly (e.g. in cold weather or when rain follows application). However, they are mostly insoluble in water and have to be used as solutions in oils or as oily emulsions in water. Preparations may be made up in the form of dusts or sprays, the respective merits of which will be discussed later.

Indian weeds killed

There are numerous publications on the hormone weed-killers, indicating that a great range of plants is attacked. Speaking in general terms, grasses are not very susceptible, and succulent annuals in a young and actively growing state are most susceptible. Some of the perennials, however, are most easily destroyed if treated at the flowering stage, for if treated earlier they tend to throw up new growth. Some perennials are extremely persistent, and several applications are necessary to ensure a good kill. In India, the most striking results have been obtained with water-hyacinth, where ½ lb. of Methoxone per acre has been found to kill all the plants, provided the leaves of each plant are effectively wetted with the solution (Figs. 1-6). Other water weeds are likewise killed, including *Pistia lanceolata* and *Salvinia auriculata*, the former being the weed which is responsible for the development of the mosquito which carries the Filaria causing filariasis in man, a very serious disease widespread in India. Promising results have likewise been obtained against *Ghokru, Xanthium strumarium* (*Chhota datura*) (Figs. 7, 8).

The most extensive use for the hormone weed-killers in temperate countries is in the control of weeds in growing crops of grain. Some of the more important of these, which have been found to respond readily to Methoxone under Indian conditions are:

Anagallis arvensis (*jainghani*)
Asphodelus tenuifolius (*piyazi*)
Argentea colosia (*safed murga ka phul*)
Chenopodium album (*bathua*)
Chenopodium murale
Convolvulus arvensis (*hirankhuri*)
Cyperus rotundus (*motha*)
Fumaria parviflora (*pitpapra*)
Lathyrus aphaca (*jungli matar*)
Leucas aspera
Medicago denticulata (*maina*)
Melilotus parviflora (*senji*)
Psoralia corylifolia (*baochi*)
Saponaria vaccaria (*dudhi*)
Sonchus arvensis
Xanthium strumarium (*chhota datura*)

These are only a few of the serious weeds, of which there are many more that will undoubtedly respond to hormone weed-killers. We lack sufficient detailed information about the behaviour of individual species in India.

The effects of Methoxone on the parasitic weeds, belonging to the genus *Striga*, which parasitize *jowar* and sugarcane, are most striking, and hormone weed-killers undoubtedly offer great promise here. As little as one-third of one pound of Methoxone per acre has proved satisfactory under some conditions.

Safe in use

The use of chemical weed-killers raises the question of their safety, not only to crops where they are used as selectives, but also to livestock, to humans, and, in the case of application to waterweeds, to fishes.

It has been found that wheat is one of the crops most resistant to hormone weed-killers; it is rarely damaged except when (1) applied to the soil almost immediately before sowing, or (2) applied at the time when the ears have headed out, or (3) applied in quite excessive dosages. Since the most effective time to kill the weeds is when the crop is about 4 to 6 inches high, the risk of damaging the crop is small. Barley and oats are slightly more susceptible to damage than wheat, but again the risk is small if the chemical is properly applied. When cereals are grown in mixture with other crops, such as mustard, gram, or other pulses, Chloroxone and Methoxone are definitely unsafe to use. Cotton is a crop readily affected. Even small quantities of spray drifting on to susceptible crops adjacent to areas being treated may cause severe damage. Furthermore, the spraying equipment if used for other purposes should be very thoroughly washed after use of a selective weed-killer.

The evidence shows that in the control of water-hyacinth, the amount of Methoxone applied is too small to cause injury even to the most susceptible known fish. It likewise seems that there is little risk of endangering supplies of drinking water provided a few

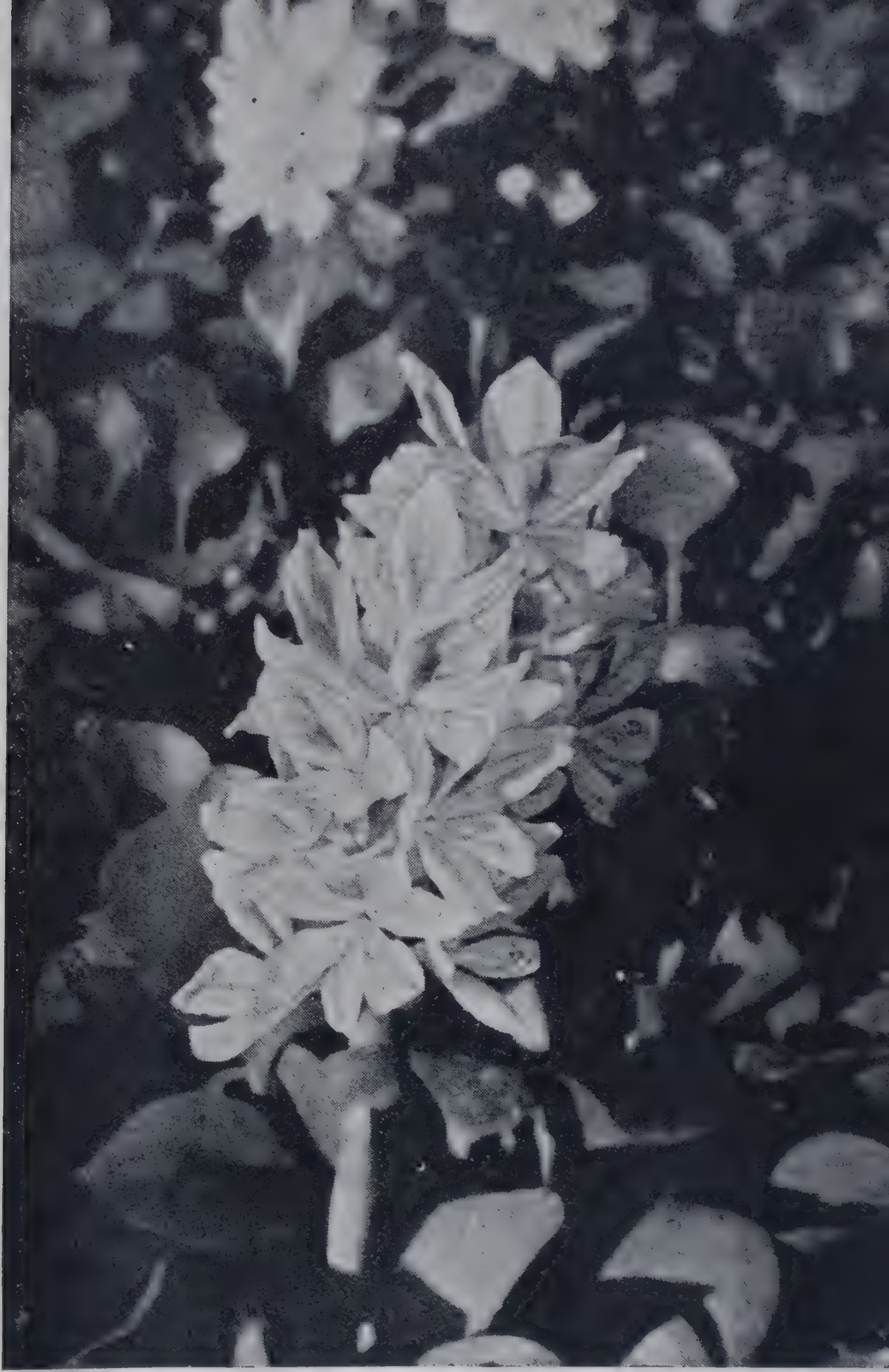

FIG. 5. A closer view of the unsprayed water-hyacinth.

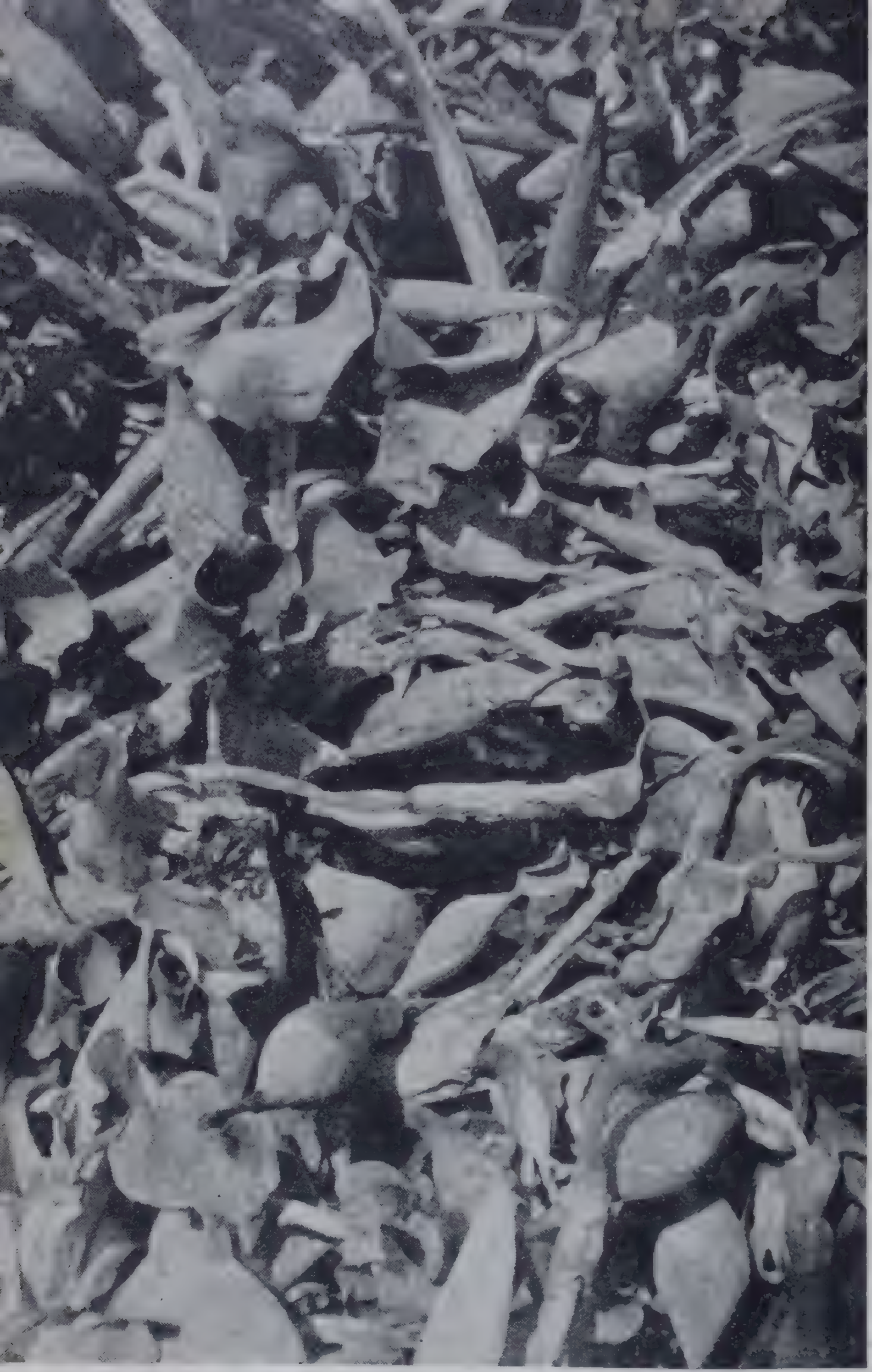

FIG. 6. A closer view of the water-hyacinth shown in Figs. 3, 4 and 5 taken eleven days after spraying.

hours are allowed to elapse before its use, and provided the tank is more than a foot deep.

The mechanics of application

In Europe and America, the greatest use of the hormone weed-killers up to the present time has been in the control of annual weeds in cereal crops, of perennial weeds, and of weeds in golf courses, lawns, etc. while the water-hyacinth has also received some attention. In application to cereal crops, Britain and America have differed; the former has developed the use of dusts, and the latter the use of sprays. Each method has its advantages and disadvantages; the more important of these are given below:

Sprays: (1) The effectiveness is generally greater, especially under unfavourable conditions.

(2) It is easier to control the application of a spray under windy conditions.

Dusts: (1) There is a big saving in the handling of water, i.e. the cost of labour is reduced.

(2) The machinery used for applying artificial fertilizers is often suitable for applying the dusts, so that there is no extra outlay.

(3) Application is speedier than with any but the high-powered spraying machines.

As far as India is concerned, water is generally available in those areas where hormone weed-killers are likely to prove most useful. Labour also is still comparatively cheap. On the other hand, the chemicals have to be sent over long distances by road or rail, and the saving and convenience of transporting chemicals in concentrated form for spraying, rather than dilute form for dusting, is not to be ignored.

Some preliminary work has indicated that the smaller the quantity of water that can ensure each plant receiving a deposit of spray on at least a portion of its leaves, the greater will be the effectiveness. That at least has applied in the case of water-hyacinth. With cereal crops, a great deal depends upon the density of growth of the crop and its age, but at 4 to 6 inches high, using ordinary types of machinery previously available in European and American farming countries, the quantity required varies from about 50 to 200 gallons per acre. With certain new types of spraying machines fitted to tractors, as little as four gallons has successfully been applied to one acre. In the middle west of America the more susceptible weeds are killed with 6 to 10 ounces of acid per acre in the form of the sodium salt, the less susceptible weeds at 8 to 12 ounces. In Britain, due to the more luxurious growth of the weeds and the crops, the quantities are higher, and where dust is used the amount may be 2 lb. In India it can be expected that the quantities required will be in the neighbourhood of the American figures. Experiments conducted so far suggest that this is the case, but these experiments have not been sufficiently extensive to enable definite recommendations to be made. However, it seems unlikely that under Indian conditions it will be possible to operate the type of machinery used in western countries, as it could not operate in small, bunded fields. Probably, therefore, small portable types of power-operated machines, of about 1½ to 4 h.p. with lengths of hose (Figs. 1, 2 and 3) will be the type to come into use first. Hand-operated knapsack sprayers could be used, but the work would be extensive and laborious. There is scope for the design of entirely new types of power machines, small, compact and portable.

In the case of water-hyacinth, it has been found that as little as 20 gallons of water will suffice to give coverage of at least one or two leaves of each plant in smallscale experiments, but in operating over larger areas it is preferable to use ½ lb. of Methoxone in 80 to 100 gallons if complete control is to be effected. In this case, the use of power machines of the type already mentioned, mounted in boats, should prove ideal. For small tanks, patches of the weed in canals, etc. which can be reached from the bank, stirrup pumps may prove useful, while in out-of-the-way places it may be best to use knapsack sprayers.

For *Striga* on sugarcane it has been found that the dust is effective at as little as one-third pound per acre, owing to the fact that the whole area has not to be dusted, but only the rows; here then, 1 per cent dust applied with rotary hand-blowers which can be taken through the rows of cane may be useful. On *jowar*, which is broadcast or sown in closer rows, it may still be necessary to use ½ lb. per acre, possibly even more, and spraying would seem advisable, again using small power machines unless the weed is present only in patches, in which case it will be better to use knapsack sprayers or dusting machines.

Economics of application

The economic gain from treating a cereal crop for control of weeds depends on four variables, namely, the cost of the chemical, the cost of the operation, the increase in yield and the price of grain. Results from other countries suggest that ½ lb. of the active chemical may be required to control the common weeds, and preliminary results from experiments on wheat in Northern India indicate that this may be true in India too; the cost of the chemical is still undetermined for India. There is no reliable information on which to base the cost of labour for spraying, except the cost of spraying plantation crops for control of diseases; on this basis it should not greatly exceed Rs. 2 an acre if done with small power machines, though hand spraying would probably cost more. Nobody knows how much damage is done by weeds, nor what the increase in yield will be. Only trials at a number of centres will provide the answer.

In the case of water-hyacinth it seems fairly likely that ½ lb. or 1 lb. of active chemical per acre will suffice; the cost of labour will probably be about the same as for spraying a ground crop.

Where *Striga* severely attacks cane, as in certain parts of Bihar, the damage caused is very great, as much as 18 to 25 per cent loss in yield over large areas, and up to 12 per cent loss in juice quality. As the amount of chemical to be applied is small, the cost of the treatment is likely to be only a fraction of the returns, and this method of control is likely to be highly profitable. Even if the treatment had to be applied twice during a season, the cost would be only a few rupees an acre and the increase in yield of cane (disregarding juice quality) might easily amount to 50 maunds, worth at present prices Rs. 75.

These calculations, however, are based on incomplete data as to the amounts of chemical required, the cost of labour, and the increase in yield, and until this information is obtained no reliable estimates of the economics of the treatments can be made.

Need for research in India

The above remarks have indicated how great are the possibilities opening up to India in the control of weeds by chemical means, and yet at the same time have shown how little is known upon which could be based practical recommendations for applying the treatments or estimates of the returns which could be expected. Some valuable studies have been made on the control of water-hyacinth, by Dr B. K. Kar at the Bose Institute, Calcutta, by Dr S. Hedayatullah at Dacca, and by Mr. K. M. Thomas, in Madras; on *Striga* by Mr. K. L. Khanna at Pussa, Bihar, and Mr. L. S. S. Kumar at Poona; on *Salvinia* by Dr Kar and by Mr. Chandraratne in Ceylon. Work on the control of weeds in cereal crops is being conducted by Dr A. K. Mitra at Kanpur and Dr Ghias-Uddin Ahmad at Lyallpur. However, a very great increase in the amount of research is required, mostly of the nature of field experiments. What is now needed is the following:

(1) Experiments to determine the dosages required to kill the common weeds in cereals (wheat, rice, *jowar*, *bajra*, and maize) under a range of Indian conditions.

(2) A series of experiments to determine the minimal dosages which will effectively control certain special weeds under pratical conditions on a large scale, notably, water-hyacinth, *Striga*, *Salvinia* and *Pistia*.

(3) Experiments with different types of machinery to determine their usefulness under various conditions, and the cost of treating a given area with each type of machine.

(4) Experiments on spray adjuvants, e.g. emulsified oils, and their effectiveness in improving the spreading or sticking qualities of the spray solutions, when they have to be applied to weeds with waxy or hairy leaves.

(5) Extensive propaganda for the control of weeds where the method is clearly profitable, e.g. water-hyacinth and *Striga*.

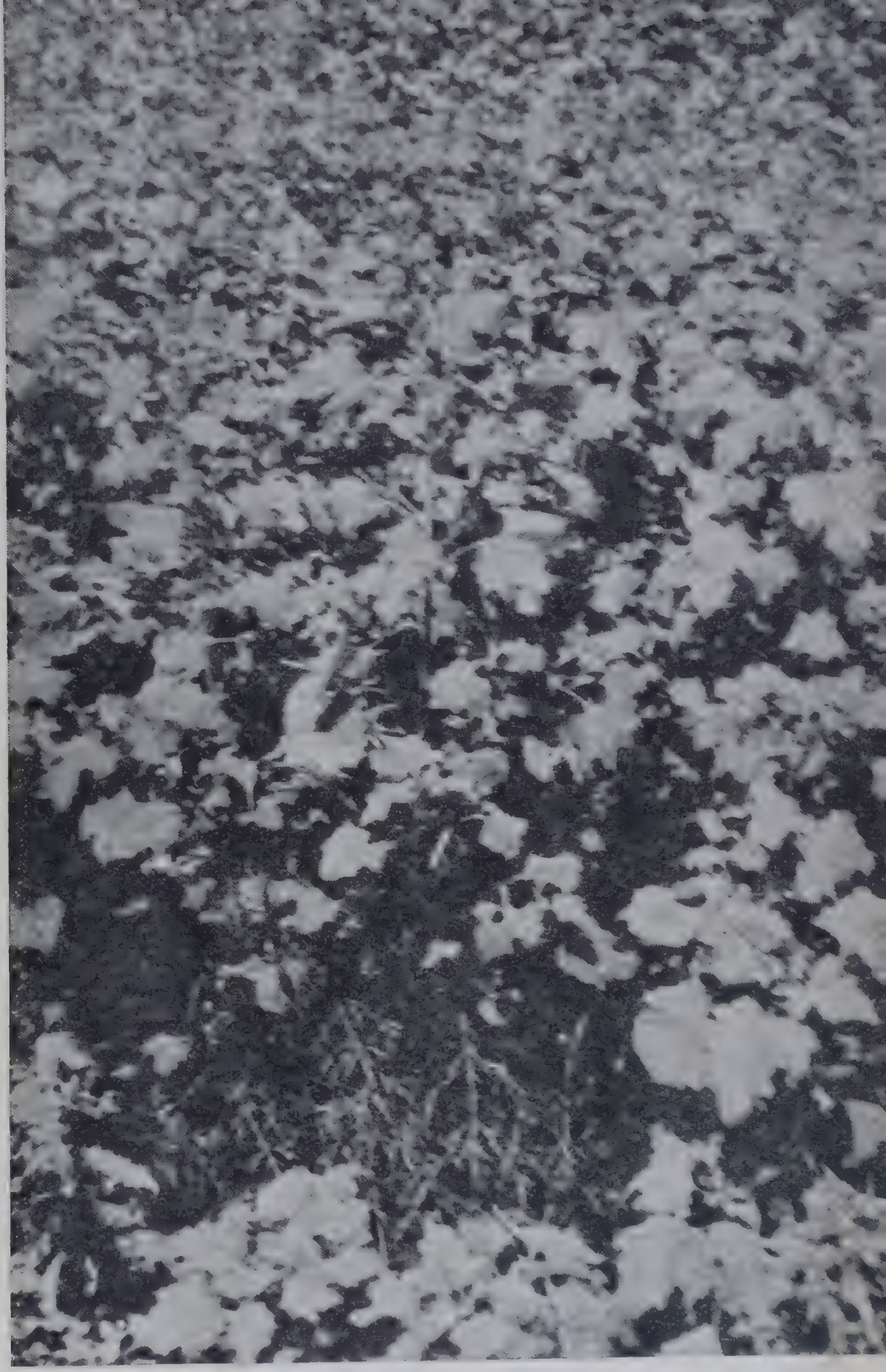

FIG. 7. *Ghokru (Xanthium strumarium)*, a serious weed in Central Provinces.

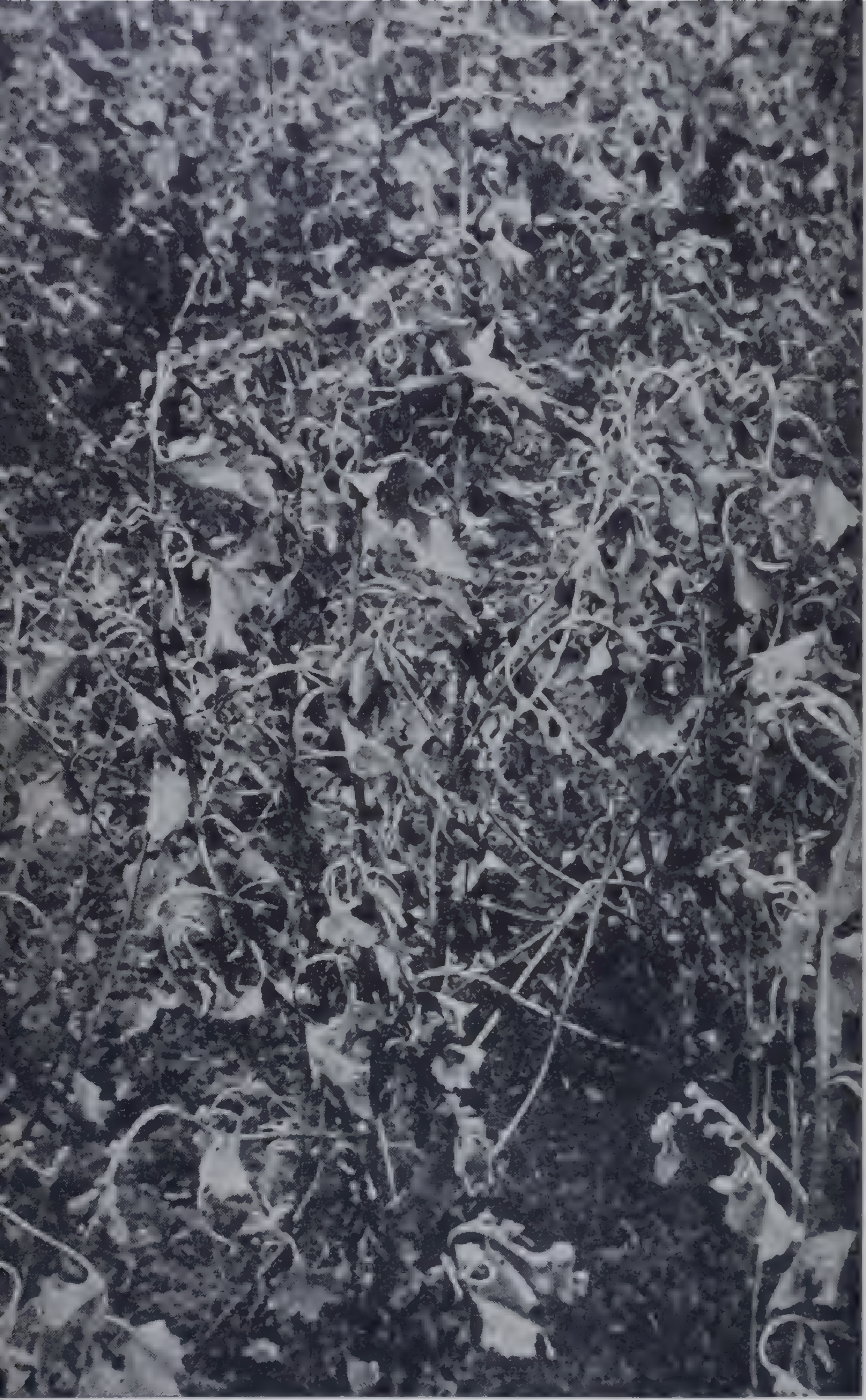

FIG. 8. *Ghokru*, the same plot as Fig. 7, twelve days after spraying with 1 lb. of Methoxone per acre in 100 gallons of water.

CULTIVATION OF EUROPEAN VEGETABLES IN DIGBOI (NORTH-EAST ASSAM)

By B. K. DAS

THE cultivation of European vegetables on a commercial scale and as a means of livelihood was a relatively new enterprise in Assam and restricted to the suburbs of big towns only till World War II. But during the war, the influx of military personnel, specially British and American, gave great impetus to it as the prices offered by them made it highly paying. During the later years of the war the cultivation of these vegetables became very widespread and the surplus after meeting military requirements was made available to the civilian population throughout the province. A taste for these vegetables was thus created amongst all sections of the people, as a result of which a ready market was assured and better monetary returns were obtained.

Yield and sale of vegetables

The author of this article was in charge of Assam Oil Company's mixed farms in Digboi during the years of war and was entrusted with the growing of potatoes and vegetables for a population of 25,000 consisting of the employees of the Company and their dependents. The results obtained by him (Tables I and II) were gratifying both in point of yield of crop and cash return in spite of many handicaps imposed by the peculiar soil and climate of Digboi and war conditions. This article is an attempt to record briefly the results and handicaps including the methods employed for growing these vegetables in the hope that farmers, and gardeners may be encouraged to take to market-gardening.

These results speak for themselves. In the year 1944-45 due to very intensive cultivation and manuring the outturn of vegetables reached its peak and realized Rs. 3,819 per acre at the moderate sale price of Rs. 15-2-6 per maund. The net return was slightly over Rs. 1,000 per acre in this year.

The quality of both vegetables and potatoes was excellent throughout and was acknowledged to be the best ever grown in this part of the country in all the vegetable shows held in the locality. Root crops, peas and beans did better than others and attained very big sizes without developing any coarseness inside or outside. English potatoes (from seeds of mixed imported varieties of the Government Upper Shillong Farm) did best of all, attaining

TABLE I

Total yield of vegetables and sale per acre

	Acreage	1942–43		1943–44		1944–45	
		Yield per acre	Sale per acre	Yield per acre	Sale per acre	Yield per acre	Sale per acre
		lb.	@ Rs. 22 per maund	lb.	@ Rs. 20 per maund	lb.	@ Rs. 15–2–6 per maund
English vegetables	21	14,112	3556 8 0	16,475	4,118 12 0	20,202	3,819 6 0
					@ Rs. 17–8 per maund		@ Rs. 15 per maund
Potatoes	9	...	...	9,020	1,973 2 0	10,444	1,957 8 0

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TABLE II

Yield of some important vegetables and sales per acre

Name of vegetables	1943–44		1944–45			Remarks
	Yield per acre	Sale per acre	Yield per acre	Sale per acre		
	lb.	Rs.	lb.	Rs.	as.	
Cabbage	24,756	6,189	28,098	4,156	11	
Cauliflower	13,184	4,120	8,914	3,479	10	Crop was poor in 1944-45 due to bad seeds
Tomato	17,712	4,428	17,822	3,364	4	
Knol-Khol	14,924	3,731	23,508	3,949	4	
French Bean	12,464	3,116	14,944	3,729	6	
Peas	9,708	3,640	7,962	2,796	12	
Turnip	11,070	2,768	11,086	2,496	8	
Lettuce	8,748	2,187	12,140	2,182	11	
Carrot	...	...	6,364	1,538	4	Seeds of carrot and beat failed to germinate in 1943-44
Beat	...	...	11,562	3,909	0	

an average weight of 2 to 3 *chattaks* per tuber. The biggest tubers, representing 15 per cent of the crop, weighed 6 *chattaks* to 9 *chattaks* each.

Handicaps

The chief handicaps encountered were the following :

(1) Highly acid, stiff and infertile soil of Digboi which was difficult to work and had to be fed very liberally and continuously with manure to enable raising of crops.

(2) Heavy rainfall, 120 to 130 inches a year, which had two phases, the proper monsoon phase which lasted from February to October and the winter phase which produced 5 to 6 inches of rain spread over late December and early January. Due to the late stopping of monsoon rains early crop of vegetables could not be grown successfully and the main crop had to be deferred till the first week of November. The greatest difficulty was experienced in growing potatoes, every operation regarding which, from planting to harvesting, had to be completed against time as barely 3½ months (early November to mid-February) were usually available for the purpose. February rain was moreover often heralded by severe hail-storm which damaged all standing crops to some extent. Loss from this cause would have been very considerable, had it not been counter-balanced by the cool climate of Digboi (elevation 550 ft. above sea-level) which arrested the decay of vegetables and prolonged the season till May, thus making it possible to grow two crops of vegetables on the same land during the same season.

(3) Humid atmosphere, which was responsible for fungus diseases that caused much damage to tomato and bean plants and all seedlings. It also restricted the cultivation of the former to new lands every year and to the coldest part of the year only.

(4) Poor quality of agricultural labour, which was usually recruited for want of better ones from immigrants like Gonds, Santals, Nepalese, and others. These had little or no experience in market-gardening and required a lot of training. Output and quality of their work were therefore quite disproportionate to the high wages (Rs. 2 per day with dearness allowance, etc.) paid to them.

(5) Bad seeds, all from renowned firms, which caused considerable dislocation of programme and loss in yield due to partial or total failure of germination. A few instances of such failures, as ascertained by germination test and subsequently confirmed in seed beds, are given in Table III.

(6) Transportation difficulties, due to which seeds and manures were often delayed or sometimes lost during transit.

TABLE III

Results of germination tests

Name of seed		1943–44	1944–45
		Per cent germination	Per cent germination
Potato	...	70·0	69·0
Cauliflower	...	60·0	31·3
Cabbage	...	57·0	49·0
Knol-Khol	...	54·0	54·5
Peas ...	...	60·0	30·0
Carrot ...	...	2·0	52·0
Onion ...	...	Nil	Nil
Lettuce ...	...	50·0	47·0
Beet ...	...	2·0	70·0
French Bean	...	70·0	58·0

Methods of cultivation

Preparation of land: After the harvesting of winter vegetables, all the plots, except those wanted for growing early Patna cauliflower and early cabbage, were ploughed and put under a quick-growing legume, usually cowpea (seed rate 60 lb. per acre) for (a) giving a cover on the land against erosion, (b) adding nitrogen and humus to the soil otherwise poor in this respect, and (c) preventing weeds and insect pests. By the second week of October when the cowpea plants had shown signs of flowering, two more ploughings were given and slaked lime at the rate of 500 lb. per acre was applied on the land. Lime hastened the decay of cowpea plants and counteracted the acidity of the decaying vegetable matter and of the soil. At an interval of a week or so, two more ploughings were given and the land was ready for planting. The land reserved for early cauliflower and cabbage was ploughed twice in June, then limed over and kept fallow till August, when more ploughings were given as weather permitted. Then slightly elevated bunds 18 in. apart were made by digging shallow drains by the side of each bund. Planting of seedlings was done on these bunds, in order to eliminate the risk of their rotting during heavy rains.

Manuring: No manure was applied to the soil at the time of cultivation. This prevented the waste of manure through erosion and through unutilized gaps in-between plants. Manure was applied to each plant individually before and after planting. It was found that the higher cost of such application was amply repaid by the saving of manure and by the high uniform yield of vegetables. Manures used were well-rotted cow-dung, mustard oilcake (powdered), wood-ash, lime and chemical fertilizers. All of them were applied direct into the holes or rows where plants or seeds were intended to grow and thoroughly mixed up or covered with earth. Seedlings were then planted or seeds sown on the same day without any ill effect. Chemical fertilizers or rotted oilcake were also applied during the growing stage, usually twice, by the sandwich method, i.e. by removing a portion of the soil around the roots, applying a small quantity of fertilizer to each plant and then replacing the soil on top of the fertilizer. Care was taken to water the plants before the application and to leave a gap of at least two inches between the fertilizer or oilcake and the base of the plant. A good substitute for fertilizers, when it could not be had, was found in a mixture of mustard oilcake, lime and wood-ash in the proportion of 3 : 1 : 1. This mixture was soaked in water for about 10 days before application. Within this period oilcake usually fermented and cooled off, thus becoming innocuous to the plants.

Planting: This was done differently for different vegetables. (a) Vegetables were planted as seedlings in manured holes, e.g. cabbage, cauliflower, knol-khol, tomato, beet and lettuce. The holes were usually 9 in. in diameter and 5 in. deep. Deeper cultivation was found to be unnecessary as roots of these vegetables spread sideways mostly. Each hole was filled with two big handfuls of cow-dung and one handful of oilcake which were then thoroughly mixed up with the soil.

(b) Vegetables were sown direct into the soil in manured trenches, e.g. potato, peas and French bean. For potato 4 in. to 5 in. deep furrows, 22 in. to 24 in. apart, were first made, by a plough dragged by two men. These were then filled up with farmyard manure, oilcake, amophos and sulphate of potash followed by one inch thick layer of soil. Tubers were planted on top of this layer and then covered up. For peas, about 6 in. to 8 in. deep trenches were made with hoe which were then liberally filled up with farmyard manure and oilcake and then covered up with soil on top of which seeds were sown. Peas had deep root system and hence the need for deep trenches and liberal doses of manure was great. Fertilizer in the shape of amophos was applied once just before flowering. Seeds of peas were found to germinate better and more uniformly when soaked in water for 12 hours before sowing. For French bean, furrows were made by plough as in the case of potatoes. Cow-dung, oilcake, and sulphate of potash were the manures used. Sulphate of potash was found to be indispensable for strengthening the stems of the plants, which otherwise invariably broke down or lodged under the weight of the crop causing serious loss in yield. Seeds were not soaked in water before planting, specially in the early part of the season, as this tended to cause fungus diseases which arrested germination.

(c) Vegetables were sown direct into the soil by broadcasting on manured beds, e.g. carrot, turnip and all varieties of spinachs. For these vegetables slightly elevated beds 4 ft. wide were made by leaving one foot wide shallow ditch in-between. Farmyard manure, oilcake and fertilizers were applied on these beds and mixed well with the soil with hoe. Seeds were broadcast on top and then put under by very light hoeing and then pressed over with a flat piece of bamboo or plank. The beds were watered before sowing and covered with bamboo-mats afterwards until germination occurred.

Watering: This was done in all crops, except in the case of newly-planted seedlings, by the trench system, which meant that water was let in into the shallow trenches in-between two rows of plants which were made at the time of earthing up the base of the plants. The two ends of the trenches were closed up, one before and the other after filling with water. This system of watering was beneficial in the following ways:

(a) Water reached the roots of the plants, kept them cool and by penetrating into the inner layers of the soil delayed the process of evaporation.

(b) The soil at the base of the plants did not get packed up and then crusted over as in the case of over-head watering. This prevented choking of the plants and saved subsequent expenses for breaking up the crusts.

(c) Less time and labour was needed for watering and one thorough soaking (either by bucket, pump pressure or gravitation) was sufficient to do away with daily watering for at least seven days.

(d) Treading and packing of the soil (at the base of the plants) by the feet of men employed for over-head watering were avoided.

Prevention of insect pests: The following simple precautionary measures were employed:

(a) No woody material was allowed to remain on the land as a preventive against the appearance of white ants.

(b) Raw or partially decomposed farmyard manure was never used for any crop. Heavy liming and frequent ploughings were given to the infected land to prevent the appearance of white and red ants and caterpillars.

(c) All the bunds and edges of the plots were kept free from shrubs or overgrown grass, so that grass-hoppers had no lurking or breeding place near growing crops.

(d) A month or two ahead of the planting season, every field was searched thoroughly for cricket holes, which were easily recognizable by freshly burrowed loose mounds of earth. After locating the holes, the insects were either forced to come up by pouring phenyle water into the holes or by laying their nests bare with the help of a hoe. Usually the insects remained in pairs. When found they were at once destroyed. A few rupees thus spent in the first one or two years, rid the plots of these pests almost permanently.

(e) Light-traps were used successfully against moths, specially white-cabbage moths. This coupled with the killing of their caterpillars by hand-picking every morning in the beginning of the season, made the damage done by these insects almost negligible.

As a result of these simple measures, the farms had been remarkably free from insect pests, except in 1942, the first year of operation. Since 1943 not one in a thousand plants was damaged by any insect and the need for insecticides was therefore entirely eliminated.

Prevention of fungus diseases: Tomato, potato and French bean and seedlings were the crops mostly affected by fungus disease in this locality. Measures adopted for safeguarding the plants were:

(a) Changing the sites of these crops every year.

(b) Restricting their cultivation to the coldest part of the year, viz. November to February. In the case of tomato specially, planting done before the first week of November was always attended with total or partial failure due to foot-rot or other fungus diseases.

(c) Using sulphate of potash for top-dressing in the case of tomatoes, and as a basic manure in the case of potatoes and beans.

(d) Using wood-ash on the stems and leaves of the plants from the seedling to the fruiting stage. Weekly sprinkling of this material on the entire plant in the early part of the morning, when dew remained on it, was found to be an effective substitute for more expensive fungicides.

(e) Using Bordeaux mixture on potato plants when they showed signs of blight after a spell of winter rains.

All these measures followed thorough cultivation of the soil and adequate liming in June-July or after the harvesting of the legume crop.

Raising of seedlings

This is usually the bogey of all new-comers in the field of vegetable production. Successful vegetable farming depends a good deal on the proper and timely raising of seedlings.

Due to the possibility of damage through late rains and for the sake of economy of labour and ease of operation, the bulk of the seedlings was raised in the farms under cover. The seed-beds were 4 ft. wide and stretched from north to south. The cover used was preferably thatch over a two-roofed structure which had a clearance of 4½ ft. between the ground and the leaves. This arrangement exposed the seedlings to the direct rays of the sun up to 10 a.m. and from 3 p.m. to sunset. This exposure was sufficient to make the plants strong, upright and healthy.

The site of seed-beds was changed to new ground every year and was limed and cultivated from June onwards and brought into a fine pulverized state before sowing. Any ordinary soil with plenty of compost or well-rotted cow-dung incorporated in it was suitable for raising the seedlings. A few days before sowing, the tops of the beds were sterilized by pouring boiling water. At the time of sowing the beds were made firm by beating with a light plank, so that small seeds of European vegetables could not get lost by passing into the deeper parts of the soil. An hour before sowing, the beds were lightly watered and the seeds were simultaneously steeped in either plain water or in 1 per cent solution of copper sulphate. At the time of sowing the wet seeds were mixed with dry sand to ensure even distribution. Dust passed through a sieve (an ordinary tin plate punctured all over by a 1½ in. nail served the purpose) was then sprinkled on top, just thick enough to cover up the seeds, followed again by light beating of the soil with a plank or hand. Shade with bamboo mats for the first two or three days was provided on the eastern and western sides of the beds to prevent evaporation of the moisture. Watering was usually avoided until the seeds germinated, which normally took place within 36 to 48 hours in the case of cabbage, cauliflower, knol khol, tomato, etc., about 72 hours in the case of lettuce and 10 days for slow germinating seeds like celery. (Lettuce required cool soil for proper germination. When sown in warm soil, the seeds usually remained dormant until the soil attained cooler temperature). Care was taken not to sow the seeds too thickly as this made the seedlings weak and prone to diseases. A 4 ft.×5 ft. bed was found to take 1 oz. of cabbage, cauliflower, tomato, knol khol, lettuce or beet seeds with 80 per cent germination. Germination tests of all seeds were taken before sowing in order to estimate the quantity of seeds needed per bed.

A week after germination and thereafter every 10 days, a light dusting of wood-ash was given on the plants as an antidote to insects and fungus diseases. Watering was given sparingly and only when the beds looked dry, as too much watering always led to trouble. In the early part of the season three-week old seedlings were transplanted in another bed and allowed to remain

TABLE IV

General information with regard to vegetables grown in the farm

Name of vegetable	Varieties used	Seeds used per acre	Best planting time	Distance		Manures used						Remarks
				Between rows	Between plants	Rotted cow-dung	Mustard oilcake	Amo-phos	Sulphate of ammonia	Super phos-phate	Sulph-ate of potash	
French Bean, Dwarf	Sutton's Surperlative or Premier	40 to 50 lb.	November to mid-December	18 in.	9 to 12 in.	75 md.	10 md.	1 cwt.	..	..	1 cwt.	Superlative produced longer and better beans. Premier was superior in quality
French Bean, Climbing	Sylhet Strain	,,	Mid-October to mid-December	18 in.	9 to 12 in.	,,	15 md.	,,	..	..	..	Yield better than Dwarf variety but offset by cost of trellis
Beet-root	Sutton's Crimson Globe	3 lb.	November to mid-February	12 in.	12 in.	,,	10 md.	,,	..	..	50 lb.	Grows better and more easily from seedlings
Cabbage, Early	Sutton's Flower of Spring and Pride of India	8 oz.	October	18 in.	18 in.	,,	15 md.	..	2 cwt.	..	..	
Cabbage, Main crop	Sutton's Pride of Asia and Eclipse Drumhead	,,	November to January	24 in.	20 in.	,,	,,	..	3 to 4 cwt.	..	..	
Cauliflower, Early	Early Patna	,,	September to October	22 in.	18 in.	100 md.	..	..	2 cwt.	50 lb.	..	Oilcake avoided, as it encouraged fungus diseases in wet weather
Cauliflower, Main crop	Maincrop Benares	,,	Mid-October to mid-December	22 in.	22 in.	75 md.	15 md.	..	2 cwt	50 lb.	..	Snowball imported or acclimatized and other imported varieties too did not do well
Carrot	Sutton's New Red Intermediate	6 lb.	,,	In beds	In beds	,,	,,	1 cwt.	..	..	50 lb.	
Knol khol	Pocha's King of Market	12 oz.	Mid-October to early January	18 in.	16 in.	,,	,,	2 cwt.	..	..	50 lb.	Transplanting did better than direct sowing
Lettuce, Cabbage	Improved Unrivalled	1 lb.	Mid-October to January	15 in.	12 in.	,,	,,	..	2 in.	..	..	
Lettuce, Cos	Sutton's Mamonoth White or Paris White	,,	,,	,,	,,	,,	,,	..	..	..	..	
Peas	Sutton's Best of All	80 lb.	November to mid-December	18 in.	6 in.	125 md.	,,	2 cwt.	..	..	..	
Potatoes	Upper Shillong Farm Seeds	15 md.	November	22 in.	8 in. to 9 in.	100 md.	,,	1 cwt.	..	1 cwt.	50 lb.	Seeds usually bigger than average market seeds
Spinach	Banerjee's Giant	8 to 10 lb.	October to December	In beds	In beds	125 md.	10 md.	..	1½ cwt.	..	..	
Tomato	Sutton's Best of All	4 to 6 oz.	November	36 in.	24 in.	75 md.	15 md.	2 cwt.	..	..	50 lb.	Removal of non-bearing shoots promoted better size and yield
Turnip	Sutton's Golden Ball or White Country	2 lb.	Mid-October to December	In beds	In beds	,,	,,	1½ cwt.	..	..	50 lb.	Also did well when seedlings were transplanted

there until big enough for planting in the open. This transplanting hardened the plants against unfavourable weather and hastened maturity. When due to wet weather or too much watering or too thick sowing, seedlings of any bed showed signs of foot-rot, the seedlings still unaffected were at once removed and replanted in a fresh bed. Seedlings thus treated very seldom developed the disease in the new bed. This was found to be the surest method for preventing loss of seedlings through foot-rot. After the removal of the seedlings, the soil of the affected bed was replaced by healthy soil from the field before using it again for growing seedlings.

In the case of early cauliflower or cabbage, two transplantings were done at an interval of 21 days and the plants were allowed to attain a height of 6 in. to 8 in. before planting in the open.

More than three lacs seedlings were grown by the above-mentioned system in the farms every year with uniform success. Of these about a lac was sold to the private gardeners every year at Re. 1 per hundred. The proceeds covered the costs of all seeds purchased for the farms and left some margin of profit into the bargain.

Table IV gives general information regarding some inportant vegetables grown in the farm.

FRUIT DEVELOPMENT IN HIMACHAL PRADESH

A PROPOSAL to put about 7,000 acres of unused forest land in the Himachal Pradesh which are estimated to produce approximately 10,000 tons of dry fruits, is under consideration of the Central Ministry of Agriculture. A recent survey of two tehsils in the Himachal Pradesh shows that the area is suitable for growing walnuts, almonds, apricots, raisins, *chilgoza* and grapes.

The scheme, when it materializes, will cover to a great extent, the fall in supply of dry fruits to India, which before partition India had been receiving through Pakistan.

CATTLE BREEDING

By JAMES N. WARNER

WE desperately need three times the amount of milk now produced. A need for better draft animals exists, but this need is neither so great nor so urgent as that for more milk.

Improvement work on our purely draft breeds is directed almost exclusively towards the improvement of their draft quality ; only sufficient attention is given to their level of milk production to assure meeting the needs of the calves. The fundamental objective or development work on milk breeds is the improvement of their milk-producing capacity ; any draft quality they may have is substantially ignored. Work done on our dual purpose cattle is directed towards increasing simultaneously both draft ability and milk-producing capacity in the same animal.

While some may consider that milk-producing capacity and draft ability in the same animal are genetically incompatible, the fact that attention is being given to the improvement of both capacities in one animal indicates not only that there are some who are not so sure of this, but that at least some workers are beginning seriously to question the ability of our national economy and our farm industry to support both milk and draft types of cattle. Such work would indicate that one animal which is characterized by both a high level of milk production and a high level of draft ability is all we can economically afford. Whether such an animal should be a zebu or a buffalo is not certain. There is no doubt a place in our economy for both of these species, provided each meets the conditions of high milk production and high draft ability at the same time.

While buffaloes are not commonly used for draft purposes for field work, there is no reason why implements cannot be developed which will enable farmers to use them effectively for this purpose. Efforts made in developing such implements might be profitable. The buffalo cow is India's most important milk-producing animal. Nearly 58 per cent of our milk is converted into *ghee*. When milk is used for making *ghee*, the buffalo is a more economical milking animal than is the zebu. There is a definite need in our economy, therefore, for the buffalo cow. Consequently we must make every possible effort to utilize the buffalo bull and bullock in such a manner as will make this species as economical as possible.

The male of our milk breeds is used, widely as a matter of fact, for draft purposes. While one may grant that it is not as satisfactory for this purpose as draft breeds are, it does a substantial proportion of the total work performed by cattle in this country. The potential draft qualities of our milk breeds have never been exhaustively studied. There are reasons to believe that greater use could effectively be made of the males of these breeds for draft purposes. Selective breeding could be employed to a greater extent in exploiting these breeds for draft purposes.

The census indicates that 3,500,000 mature bovine females, that is zebu and buffalo cows, are used for draft purposes in India and Pakistan. There is no scientific reason why many times this number should not be so used. While there are conditions under which cows should not be worked, there are conditions under which they should be worked if we are to maintain them economically.

The village farmer is characterized by a degree of independence of peculiar interest to this discussion. He considers it necessary, for example, to possess his own bullocks in numbers adequate to meet the demand for draft power, seasonal or otherwise, on his own holdings. This involves at least one pair of bullocks. This was true of his father as well. What is peculiar in this, however, is the fact that whereas a man's father may have operated his holdings with one pair of bullocks, *each of his sons*, having inherited an equal share of the father's holdings, *now demands one pair of bullocks for his smaller holdings*. The present generation insists, therefore, that a number of

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bullocks greater than required by the last generation is now needed to till the land. The number of bullocks required will continue to increase to the extent to which such division of holdings continues. Should such division of holdings discontinue, this factor would cease to be so influential in this respect. It has gone so far already, however, that certain portions of our land could undoubtedly be operated with fewer—oddly enough, not necessarily better—bullocks.

There are some who are convinced that the improvement and development of agricultural machinery, expected during the next few decades, will gradually increase the efficiency of farm bullocks. As this development occurs, either the rate of increase in the required number of bullocks will diminish, the rate of increase in the required quality of bullocks will diminish, or both.

Large areas of new land are being brought under cultivation. Some of this land will be operated by power machinery. As this is done, the increased area under cultivation will be handled without increasing the number of draft animals. There is talk of consolidating holdings. This would enable the operating of power machinery in many areas. As such machinery is employed the rate of increase in the required number and/or quality of bullocks will likewise diminish.

To the extent to which fewer bullocks, bullocks of the same quality as, or only slightly better than, we now have will suffice; to the extent to which holdings are consolidated and/or operated by mechanical power; to the extent to which better implements, including those designed for buffaloes, are used; to the extent to which cows, whether zebus or buffaloes, are worked; to the extent to which all of our cattle are better fed, and cared for; to that extent the need for genetically improving our purely draft animals or of increasing their number actually diminishes.

That our need for milk is at least three times the quantity we now have is unquestioned. So long as milk is produced by cows, whether zebus or buffaloes, nature will produce animals which can be used for draft purposes. These will consist of a majority of the males and some of the females of whatever species are used for milk production. Since we have so little use for cattle as meat animals and since we are inclined to insist that whatever cattle we have be allowed to live, we force ourselves, in economic self-defence, to seek other uses for them. Our supply of animal food is not adequate to maintain one-half of our cattle while making absolutely no economic use for them. In self-defence we shall seek some means of utilizing them by which their maintenance will be economical. We shall undoubtedly work them.

In view of the possible need for less highly developed draft animals than some may consider essential, if not actually fewer such animals, and in view of our need for many times the milk we now have, it might be worth considering very seriously whether wisdom should not dictate a policy of exerting all our efforts towards improving the milk breeds of both the zebus and the buffaloes without giving special consideration to the development of the purely draft breeds.

One may venture to suggest that our need for draft animals would be met satisfactorily by the males, except for the relatively few required for breeding purposes, and which could be readily selected, and certain of the females of such improved milk breeds.

GHEE PRODUCTION ON COOPERATIVE BASIS

THE scheme has been worked by the Indian Council of Agricultural Research in the Jhallar tract in Central Provinces with the object of organizing cooperative societies for the primary producers, the gaolies, for enhancement of *ghee* production by better feeding of stock, better technique of production and also by improving the milking capacity of the livestock by scientific means. The scheme by organizing better marketing system and enabling producers to put their produce direct to the consumers without the mediation of middlemen, would secure better returns from the sale of their products.

This experiment has worked successfully for a period of five years. There are 119 members in the cooperative society, comprising of 84 goalies, 33 non-gaolies, and 2 aboriginals.

The capital of this Union is Rs. 10,000 divided into 1,000 shares of Rs. 10 each. Up to last year the number of shares subscribed was 387 amounting to Rs. 3,870 as contributed capital. Of this the gaolies has taken 109 shares amounting to Rs. 1,090. The gaolies could not contribute more because of their extreme poverty and heavy indebtedness. With the working of the scheme however they have been able to liquidate their loan to the *bania* and it would now be possible to raise further share of contribution towards the capital. Cheap loan facilities were granted to them by the Central Provinces Government.

In order to get the maximum returns for the Jhallar *ghee*, the sale of *ghee*, which was organized at various centres in the Central Provinces, was discouraged and efforts were made to dispose of the greater quantity of *ghee* at Nagpur.

The trading account of *ghee* and other sub-sections showed a gross profit of Rs. 8,091 while the net profit earned is Rs. 837-9 after defraying the total working expenses of the Union of Rs. 5,970-9-6, which included interest on the loan granted by the Government as well as depreciation.

In addition to the functions of producing and selling *ghee* on cooperative basis, regular milk recording at the headquarters of the Union has been introduced, with a view to illustrate to the gaolies the uses of milk recording. Better types of sires have been introduced and uses of feeding concentrates illustrated.

In the future programme of the scheme, it is intended to introduce cream separators, but that will only be done after the whole problem of the economic use of butter-milk *vis-a-vis* the separated milk has been studied. There is also a provision for the preparation of silage, which will be useful for feeding to the animals during the scarcity period. The scheme is being run under the supervision of the Animal Husbandry Department of the Government of Central Provinces and Berar. (H.K.L.)

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Service in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Will you please let me know the following:

(1) The right quality of barley for making Pearl Barley and barley powder.
(2) The market or location where I can obtain these qualities.
(3) The process of manufacture of Pearl Barley and barley powder.
(4) The varieties of oats and the process of manufacture of oatmeal. (R.A.)

A. (1) Barley is grown mostly in the United Provinces (with about 70 per cent of the total acreage), Bihar and the Punjab, with a total area of 6,247,000 acres and production of 1,958,000 tons in 1945-46. Two varieties of barley are grown, the two-rowed (*Hordeum distichun*) and the six-rowed (*H. vulgare*) which are subdivided into hulled and hulless and again further subdivided according to the different cultivation of the grain.

Pearl Barley is barley from which the outer husk and part of the bran layer-husk has been removed. The requirements for Pearl Barley are in some respects similar to these for malting barley. The grain must be sound, sweet and cool, plump and heavy-berried; must not contain too much moisture and must not be musty, mouldy or contain any heated or damaged kernels. A strong well-developed, sound and whitish-coloured grain with high nitrogen content is preferred. Uniformity in the size of the grain is important as uniform grains give good finish and attractive appearance to the product. The imported commodity fetches better premium mainly due to the uniformity of grains. And it is significant that imported Pearl Barley is manufactured from the two-rowed variety in which the size of the grain is not uniform, while in India it is manufactured from six-rowed variety where there is comparatively better uniformity in the grains.

Types 4 (Rewari) and 5 (Lyallpur, E) of the six-rowed variety were recommended as malting barley in the Punjab; they may be suitable for pearling too. However, when the manufacture of Pearl Barley was taken up in Amritsar, Type 155-B and a special two-rowed type were considered the best.

2. The information asked for may be available with the Department of Agriculture, East Punjab, the United Provinces and Bihar and the Department of Marketing and Inspection of the Ministry of Agriculture.

3. Pearl Barley is produced by removing most of the bran and germ without actually grinding the grain. The machine employed for husking works exactly on the same principle as the ordinary rice hulling machine, the only difference being that in the case of rice the material is passed through the machine 1 to 5 times whereas in the case of barley, it is passed 11 times to accomplish complete removal of the husk. A maund of barley yields 18 to 22 seers of Pearl Barley. There is a wastage of one seer per maund, the balance being barley flour and husk. Indo-chemical Works, Amritsar, manufactured Pearl Barley and the *Report on the Marketing of Barley in India* mentioned another 11 companies in Bengal and Kashmir.

Barley powder is obtained by powdering the husked grain of barley (Pearl Barley) by means of a crusher. The resulting powder generally contains coarse particles (*sooji*) which may be removed in a dressing machine.

4. Oats is cultivated in India mainly for fodder purposes. However some good varieties like French husked Algerian, FOS 1, etc. are cultivated in Gurudaspur, Jullundur, etc. in the East Punjab. For the manufacture of oatmeal, the grain is cleaned, dried and separated according to size. The graded oats are then hulled, the grain liberated and separated. The cleaned grains are then cooked in digestors with steam, after which they are rolled between large steam-heated steel rollers which crush the grains to form the well-known flakes of the rolled oats of commerce. According to the Federal Food and Drug Administration, U.S.A., rolled oats should contain not more than 12 per cent moisture, 1·5 per cent of crude fibre and 2·2 per cent ash and not less than 2·24 per cent nitrogen. (M.R.P.)

What's doing in All-India

BOMBAY

R. S. DUBHASHI

AGRICULTURE is the main industry of India and it is but proper that Colleges of Agriculture should exist in every region. After the Poona College of Agriculture, the Institue and College of Agriculture was started at Anand in Kaira District to cater to the needs of Gujrat. Last year, a College of Agriculture was started at Dharwar to cater to the needs of Karnatak in Bombay Province. Thus Bombay Province can now boast of three Agricultural Colleges—one at Poona, the other at Anand and the third at Dharwar. The College at Dharwar is still in the process of being built up but it has attracted a good number of students. There is at present a provision to admit only 75 students every year.

Minor irrigation works

The scheme for minor irrigation involves the investigation and construction of minor irrigation works, viz. tanks and *bandharas* on perennial and other streams with a view to providing a sure source of water for irrigating food crops. It is intended to spend one crore of rupees on this item during the course of five years. The minor irrigation section was formed in May, 1947 and at the end of 1947, thirty-eight projects were formulated as under :

	Number of works	Estimated cost of work at present rates (in lakhs of Rs.)	Area likely to be brought under irrigation (acres)
1. Works for which plans and estimates have been sanctioned by competent authorities and works commenced.	12	26·75	4538
2. Works for which plans and estimates have been sanctioned by competent authorities and tenders invited.	8	15·44	2735
3. Works for which approval of the Government has been received and tenders are invited	2	9·52	1480
4. Works which are before the Government for sanction	6	63·53	13341
Total ...		115·24	22094

Actual work has been started on 10 of the works mentioned at No. 1 above.

Dairy development

A thorough survey of the Poona city has been completed and projects for augmenting the milk supply of the City are awaiting sanction from the Government.

A scheme for establishing a Cooperative Milk Supply Union at Poona has been submitted to the Government. This scheme envisages the formation of primary cattle breeding and milk-production societies in the villages on the Poona-Satara and Poona-Poud roads and establishment of a permanent dairy industry on a sound footing in the rural areas within a radius of 30 miles. Under this scheme, the milk would be collected on road sides, transported to Poona for pasteurization, etc. and distributed to consumers through

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the depots to be established. At each village it is proposed to maintain a superior dairy bull for grading the village animals, and provide other help in the form of interest-free loans and subsidies. Other schemes such as dairy colonization at Wakad Farm near Poona and establishment of milk-*cum*-bull production farms at Kapasewadi and Deolali are in hand. River banks round about Poona, are also being investigated in order to find out whether these can also be developed into milk-producing belts. A scheme to help *bona fide* dairy farms if they would undertake to produce milk on modern lines and augment the milk supply substantially by offering loans at 4 per cent interest is also under contemplation.

Vegetable development

After studying the acreage under vegetables, the present production and the requirements of vegetables by the population on the basis of nutritional standards, a scheme to extend vegetable cultivation to the extent of 57,000 additional acres during the course of five years, was launched in the Bombay Province from 1 August 1947. A short survey of the present acreage and potential areas for vegetable extension in the various districts was quickly completed and the areas fit for extension were spotted out. Taluka-wise targets of extension were set out and during the first year ending 31 July 1948, an additional area of 4,655 acres was brought under vegetable cultivation. In addition to this, nine proposals for concentrating vegetable cultivation to the extent of 1,885 acres along rivers and *nalas* depending on the construction of *bandharas* or setting up of oil engines were submitted for implementation to the Minor Irrigation Department. Fallow lands to the extent of 200 acres were spotted out and the departments concerned were approached to allot these lands to prospective vegetable-growers. Assistance was given to the vegetable-growers in the matter of supply of seeds, manures, oil engines, control of pests and diseases. Efforts were successfully made in organizing vegetable growers' co-operative societies at three places. In the matter of marketing of vegetables, the railway authorities were approached to help the cultivators in the matter of quick transport and venues for rational distribution of vegetables by opening new markets for sale are being found out. Shows and stalls were arranged at four places where propaganda was made to make the people vegetable-minded. In fact, the problem of vegetable development is being tackled in its various bearings with the idea of bringing about the desired extension.

A special scheme for the extension of sweet potato cultivation in 15 districts to the extent of 2725 acres in 1948-49 is under way. In this scheme it is intended to give subsidy in the form of vines and manure-mixture to the sweet potato-growers at a total cost of Rs. 82,000.

Potato extension

The potato supply and extension scheme is aimed at the supply of 50,000 bags of seed potatoes to cultivators in Poona, Satara, Ahmednagar, Belgaum, Dharwar and Nasik Districts. Groundnut cake is intended to be supplied to the potato-growers at the cost price. Fifteen thousand bags of seed potatoes were purchased and supplied to cultivators in Dharwar, Belgaum, Satara and Ahmednagar Districts. In Poona and Belgaum Districts, the cultivators have planted their own seed and this gives an additional use of 15,000 bags of seed potatoes for planting. Before the war, seed potatoes were imported from Italy but now the *Numbri* variety of potato grown in Simla Hills is found to be the most suitable for cultivation in Bombay Province. Accordingly the seed potatoes are imported every year from Simla and supplied to cultivators. The total requirements of seed potatoes for the province including States are estimated to be 300,000 maunds and arrangements are being made to procure and transport the seed in time. A total production of 2·8 million Bengal maunds of potatoes is aimed at in the next *rabi* season of 1948-49.

ASSAM

H. K. NAG CHOUDHURY

ASSAM was so long dependent on the goodwill of other provinces in the matter of training the students in veterinary science. The number of seats offered by the Veterinary Colleges of different provinces regulated the strength of the Veterinary Graduates of the province. Of late, it became very restricted, obviously due to the necessity of increased number of Veterinary Graduates in other provinces. As a result, Assam fell short of its strength to man all the dispensaries within the province. This happened at a time when people were demanding more dispensaries in a number of places. The popular Government of Assam realized the grave danger of such a situation, and they decided to have a Veterinary College of their own in the province.

Assam Veterinary College

The Government decided to locate the College at Nowgong which happens to be a centrally placed district in the province, and to expedite the inauguration of the College, took a few rooms of the Nowgong College temporarily, pending the construction of the building of the Veterinary College. It was there that the Hon'ble Premier performed the opening ceremony of the College on 18 August, 1948, in the presence of a very large gathering. The Hon'ble Minister of Agriculture also graced the occasion by attending the ceremony. Both the Hon'ble Premier and the Hon'ble Minister of Agriculture in their short but illuminating speeches gave a graphic account of the sad plight of the cultivators which is due to the inadequate number of Veterinary Graduates in the province.

H. K. NAG CHOUDHURY is Veterinary Assistant Surgeon, Shillong.

Field Assistants

The inauguration of the College, however, does not immediately solve the question of shortage of qualified Veterinary Officers in the province. Veterinary aid is needed in every house of the province. The Government have, therefore, decided to increase the number of Veterinary Field Assistants who are trained in mechanical work, such as inoculation, vaccination, castration and first-aid. These Field Assistants will be spread out throughout the length and breadth of the province and will work under the control and guidance of the Veterinary Assistant Surgeon of the area.

In the present circumstances, this is the maximum that can be done to help the livestock owners of the province.

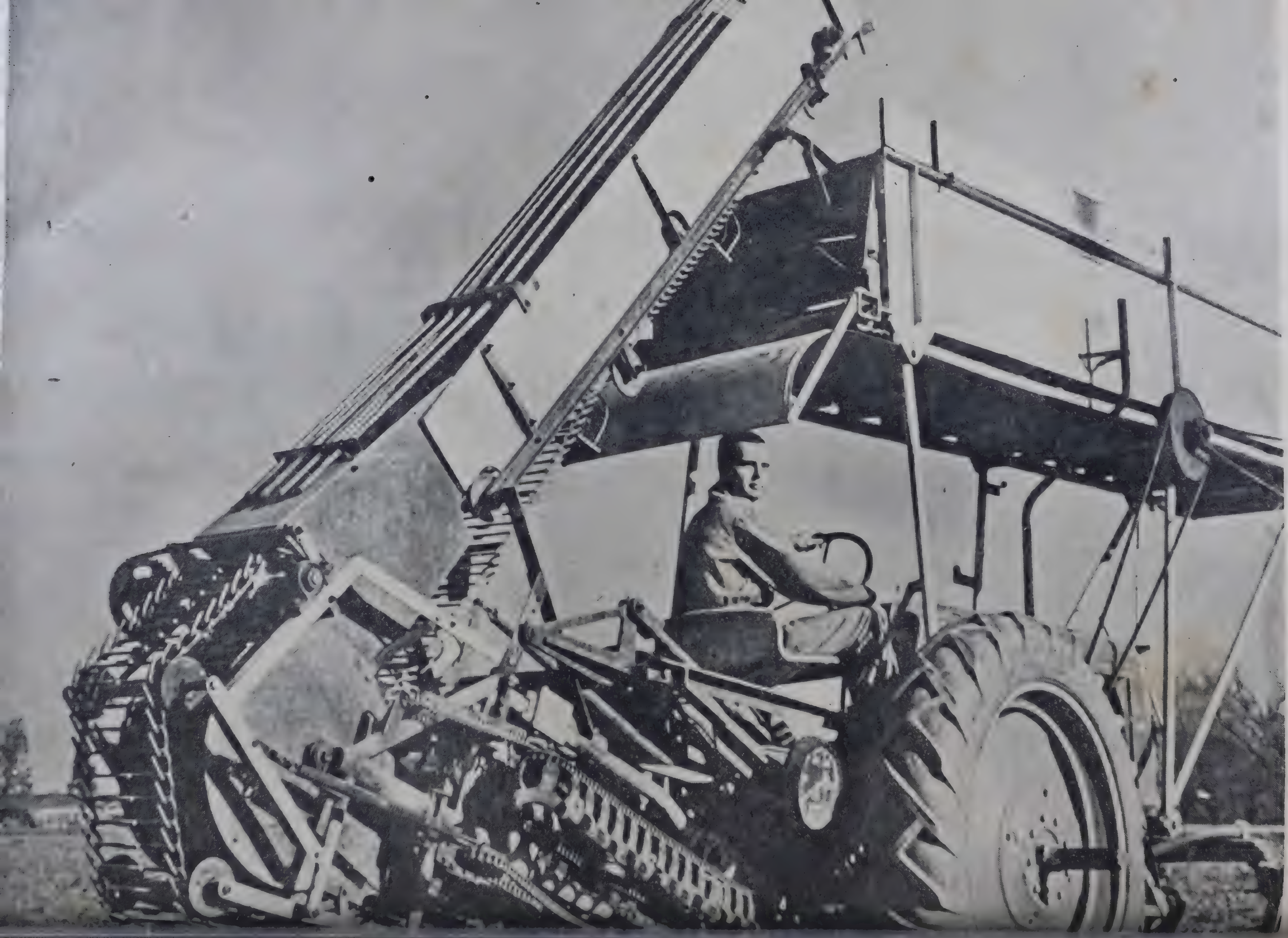
Flood

Assam has become almost an annual victim of flood, and the cattle population and other livestock are always the first casualties. Whatever fodder, good or bad, is available is generally given to them as food, with the inevitable result that the health of the livestock become deteriorated; epidemic diseases follow.

The recent flood in Assam, almost from one end of the Assam Valley to the other, brought the Veterinary Department face to face with a critical situation. The Veterinary Department with its limited strength, however, dealt with the matter with determination and not only took a leading part in procuring fodder for the livestock but also forestalled the chances of the outbreaks of epidemic diseases by immediate inoculation and vaccination of the cattle population of the affected areas.

FIG. 1. This sugar-beet harvester has released American farm workers from a backbreaking job and has solved the problem of mechanically harvesting vegetable crops of unequal height and lateral position in rows.

PLATE 38



Across the Borders

FARM MACHINES TURN FIELDS INTO FACTORIES*

By LADD HAYSTEAD

IN 1927 there were more than 15,000,000 horses on American farms; today there are only about half that number. Before the war there were 1,000,000 more workers in the fields than there are today, and 1950 will probably see even fewer men on the farms. This historic shift has been brought about by farming at long last catching up with industry in the use of machines. But unlike industry, the new farm machines did not as a rule come from laboratory or research departments. The farmers themselves are the fathers of modern farm mechanization. More often than not, the contraptions they invented were machines that by engineering rule 'just could not work'. But, unfettered by rules, these explorers of the soil went right ahead and made them work.

Farm machines used to be as standardized as a hoe, designed for use in any part of the United States. Now many are built for just one crop in one locality. The old-time 'full-line' companies are not that any more. To be actually full-line would mean stocking thousands of items in addition to the already huge inventories the big companies must carry. So small companies build and service locally designed machines right in their own backyard.

Typical of the way rural inventors harness imagination is the application of the vacuum cleaner to the fields. In the west coast State of California, a huge, portable 'sucker-upper' was built to glean ladino clover seed. Besides doing the work of large numbers of labourers, the machine paid for itself in the extra seed it saved over any other harvesting method. Vacuum sweepers also have been designed to pick up apricots, almonds, and filberts after they have been shaken off the trees. And there is a mechanical tree shaker: simply a pole or cable that jerks back and forth when hitched to a tractor pulley. During the war the hop crop was in danger of being lost because of labour shortages. It was saved by an improvised portable hop-picker. Then came a mobile vine-seed harvester to collect pumpkins, melons, and gourds whose seeds are a speciality crop. Bren-gun carriers on surplus sale were snapped up by rice farmers who always had trouble entering the wet fields to unload the rice combines.

The Pacific Coast is not the only area that has felt the impact of mechanization. Sugar-beet fields from the States of California to Michigan are almost empty of the crews of tens of thousands of 'stoop' labourers that used to do the man-killing work of beet culture. Now the seed that comes naturally in rosettes is segmented by a sort of motor sander. The seed is then planted by new precision seeders. By this method, beets no longer grow in clusters that have to be thinned out by hand. Weeding can be done by machine-powered check-rowing or cross cultivation. Then the most intricate of all the new machines, the sugar-beet harvester, comes along, doing the work of anywhere from 10 to 75 men.

This beet harvester, in its newest form, cuts the beet tops off and delivers them at the side for making cattle feed. The beet itself is gently freed from its tight soil packing so the tap roots will not be broken (as in early models). Then it is lifted, shaken clean, and elevated to a hopper riding above the tractor and mounted digger. The hopper has a moving bottom sheet that gently pushes the beets ahead so that the box may be filled without bruising the easily damaged tubers. A big hamper enables the machine to work to the end of a row where a collection truck waits. Soon an onion digger, now under field testing, will take the pain out of harvesting that crop. This machine is mounted on a tractor. It is light and fully automatic. It snatches the onion from the ground by its green topknot, shakes it, snips off the greenery, and delivers the bulb either

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*Reproduced from *Popular Science*, May, 1948.

to the side or directly behind to a pulled trailer.

In the New England States, some tired farmers have developed a stone picker to remove the endless crop of rocks from the fields. In Wisconsin, an amateur has put hydraulics to work in a hay baler, getting away from the heavy flywheel that pushes the plunger in most models. In Louisiana, a mechanical sugarcane harvester is at work. Not so long ago, most farmers could not afford tractors; there was not enough steady work to justify the cost for the very few jobs they could do. But during the war, farmers and inventors everywhere started to build their own tractor attachments. These gave the power units uses not even dreamed of a few years before. A combination front-end attachment, for instance, can be an excavator, manure loader, terracer, snowplough, ditcher, and elevator all in one. Posthole diggers for tractor attachment are now a feature of every American farm show. A mounted, power-take-off concrete mixer for the Ford tractor is on the market. Wood saws are appearing that work either from the tractor pulley or the power take-off.

One ingenious man concluded that painting farm buildings the old way was the hard way, too costly, and too dangerous if one had to lug ladders all day and possibly fall off one. So he built a scaffold on his tractor elevator and attached a paint spray to the engine. Now he can be lifted up and down, driven laterally or from job to job by his son. The power spray makes it possible to paint in hours what took days with hand brush.

The three-legged stool, badge of the dairyman, is disappearing just as fast as farmers can get materials to build milking platforms. Now the cow climbs a ramp, stands in a stall at hand level instead of the man stooping down.

Silos are now fed out by electrical unloaders, while barn gutters are cleaned by mechanical gutter washers. Hay is elevated into the mow by mechanical bale elevators in some places; it is blown in as chopped hay in others. It can be brought in from the fields, either as long or chopped hay, in a high state of moisture for mow-curing in new installations using heated air blown up through floor ducts. Some users say they can just about make hay while the rain falls.

Perhaps the most exciting news of all is that America now stands on the threshold of industrial farming with chemicals. Large acreages of corn in the Mississippi Valley, apparently doomed in 1947, were saved by the insecticide 2,4-D. This chemical is now in such demand by scientific-minded farmers that 1948's total production of millions of pounds will not satisfy even a fraction of the requirements. And right on 2,4-D's heels comes the announcement of other selective killers, to lighten the farmer's work. These and numerous other chemicals suggest that mechanical cultivation may become as outmoded as the wooden plough. Weeds and pests probably will be controlled completely by spraying and dusting. Some farmers are talking of combining the insecticides with fertilizer so that one trip over the fields can do two jobs.

This is one of the things that has brought airplanes into the farm picture. Planes spray fields for weeds, bugs, fungi, and fertilization. In the American south-west, airplanes are seeding vast areas of over-grazed range as well as tree lands for reforestation. Killing leaves on cotton plants to pave the way for the big mechanical harvesters is almost entirely a plane job. In California, planes are used for herding wild fowl away from rice fields.

Perhaps the strangest of all ideas came out at a recent North-eastern Forage Conference. In Cambridge, Massachusetts, a maker of ultrasonic equipment announced strange and wonderful things that were being done with sounds above the hearing capacity of human ears, sounds like those made by silent dog whistles. With them such fantastic things as stopping the action of yeasts and killing bacteria can be done. There was an immediate request for experiments using sounds to halt all chemical action in a silo. With such a device, forage crops could be brought from the field when their carotene content was the highest. Regardless of weather, they could be dumped into the silo and literally 'sound frozen'. No bug, germ, bacteria, or enzyme could get in its destructive work until the silage was opened.

Thus it seems possible, at least on paper, for milk cows to give as rich, cream-coloured milk in January as in June, solving another farm problem. And if ultrasonics can do this for hay, there is little reason why many other feed and food crops cannot be protected in storage

FIG. 2. The mechanical tree-shaker is an American farm-invented device. The tractor-powered device shown here can shake out 50-foot walnut trees at the rate of 10 acres a day.

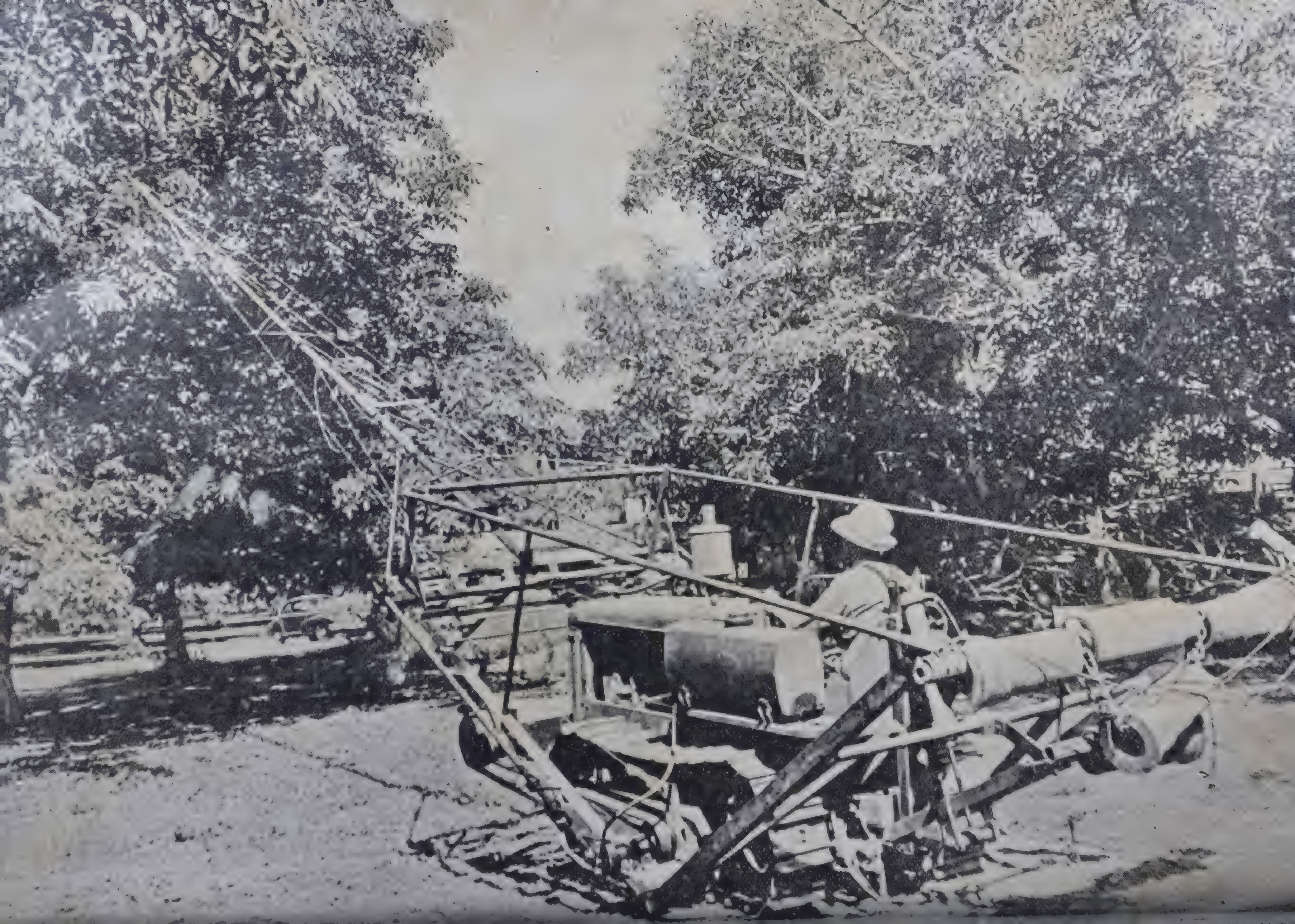

FIG. 3. To preserve the humus content of their farms, modern American farmers chop and turn under all organic matter as this roller-chopper is doing to the leaves and stalks of a date grove in Southern California.

PLATE 40

for long periods of time. This would mean a saving of possibly billions of dollars a year now lost on crops in storage that are destroyed by bugs, weevils, and fungi. The perfection of this technique is close enough at hand so that provisions for its use are already being made in flour mills and grain elevators.

Today helicopters and infra-red rays are used to protect orchards from frost; dry ice from airplanes is making rain; germicidal lamps are protecting poultry from disease; and radios that bring in the latest in sports and world news are in the barn and on the tractor. (Released through *U.S.I.S.*)

MANUFACTURE OF SUGAR CANDY

UNDER the auspices of the Indian Institute of Sugar Technology, Kanpur, arrangements have been made for training in the manufacture of sugar candy and confectionery by improved scientific process. Details of the course and the prospectus can be had, free of charge, from the Chemist-in-Charge, Sugar Candy Research Scheme, Ravalgaon, District Nasik, Central Provinces and Berar.

The Sugar Candy Research Scheme has been working under the guidance of the Indian Institute of Sugar Technology for the last eight years with a view to improving the manufacture of candy and confectionery. Researches relating to the use of steam and modern machinery for the manufacture of sugar candy and the economic utilization of mother liquor for the manufacture of high grade confectionery have been made. The processes developed have reduced the cost of production appreciably and increased the output of sugar candy. It has been possible for the first time to produce bright, lustrous, large independent and well-formed candy crystals in a specially designed Rotary Candy Crystallizer.

Advice can be given, on application, to interested persons in matters pertaining to processing, equipment and quality control involved in the manufacture of candy and confectionery. Training is also imparted to interested chemists. The training period is one month and usually starts from January each year. (*P.I.B.*)

Home Gleanings

COTTAGE INDUSTRY IN INDIAN ECONOMY

By KAPIL DAS UPADHYAYA

COTTAGE industries are bound to play, as they have done in the past, a very important part in shaping our national economy. As the National Planning Committee has pointed out, in its instructions to the Manufacturing Sub-Committee, 'they will provide a very considerable proportion of consumers' goods and employment to a very large number of workers'*. An emphasis on the proper development of cottage industries, therefore, does not necessarily imply a corresponding check on the development of largescale industries. If the experience gained in other countries of the world, such as Switzerland, Sweden and Japan, etc. can be a guide to us, we can so organize the development of cottage and largescale industries as to make them a source of strength for each instead of originator of tension and conflict. The Manufacturing Industries Sub-Committee of the National Planning Committee express the same opinion when they say: 'We feel that, by judicious adjustment, it is possible to establish a beneficial cooperation between largescale and cottage industries'. But judicious adjustment is one thing and undue bias in favour of cottage industries is another and it is from the latter that there is danger of incalculable harm being done to our national economy. Prof. K. T. Shah has already sounded the warning when he remarks: 'It is a matter of grave concern in the National Planning of India that the accepted policy of the most considerable political party in the country inclines in favour of small-scale industry or handicraft'.

Is it possible to ascertain the respective scope of cottage and largescale industries with due regard to balanced development of our national economy? While a detailed answer to this question can be the proper function of a 'permanent board of research charged with the responsibility to go into the changing economics of largescale and cottage industries, including its reactions on those employed in the cottage industry, and a much larger number of consumers as a result of which the State may decide their respective scope', certain broad principles demarcating their respective spheres may be analyzed.

If it can be proved that the cottage industry, as a basis of productive organization, is incapable of producing certain products in sufficient quantity to meet national demand or that the cottage industry products are inferior in quality to the products of largescale industry, no additional argument is needed to discredit them. But, on the other hand, if the products of cottage industry can compare favourably with the largescale industry (mill) products on both the quantity and quality plane, we should not discard them merely on the ground that the latter are cheaper. It is because 'cheapness' simply reflects the cost of utilized means of production and does not take into account vast human power running into waste for want of employment. In order to have a proper comparison of costs of cottage and mill products from national point of view, we should add to the cost of mill products also the cost of human power rendered idle as a direct consequence of it, especially when it has not been engaged elsewhere. At the same time, the comparison will not be proper unless due allowance is made of wastage of raw materials in the respective systems of production. Besides, the mill products costs would probably increase if workers in the mills were to be given wages sufficient to bring them the same material comforts, including those derived from fresh air and ample sunshine, which are enjoyed by a cottage industry worker.

It is generally believed that external economy advantage is the monopoly of mill production. Nothing can be farther from the truth. If a nucleus of cooperative organization is developed, even cottage industries can derive the advantages of external, as well as internal, economy of largescale factory production.

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* National Planning Committee Manufacturing Industries Sub-Committee Report, p. 185.

The greatest asset of largescale factory production from the national point of view is that one person taking the initiative can go a long way in solving the quantitative problem of production, whereas, in cottage industry, the initiative must spring from each cottage industry worker. The ancient cottage industries were traditional and demanded no initiative as it was supplied by caste; in modern times, those types of cottage industries cannot survive as they have to adjust very often to the changing circumstances. The problem of initiative can be solved, to some extent, by developing cooperative societies and to a greater extent by a proper system of education. That is the greatest hurdle which the cottage industry has to cross before it can march towards progress and prosperity.

If largescale factory production reduces the worker to the status of machine slave and makes him subject to hard discipline and routine, the cottage industry provides him so much freedom that only those of them can earn a decent living who are industrious by nature and such workers are few among many. If the enjoyment of leisure becomes excessive the worker and his dependents have to pay necessary price in privations.

The cottage industries save the worker from the vagaries of the employer but the largescale factories too play the noble part in rescuing the worker from the severity of many tasks.

It goes without saying that largescale factories are generally profitable—or can be made profitable—to the individual capitalists. Are they profitable to the nation also? The answer to the question does not simply depend on what quantity of product they contribute to national dividend but also the number of persons employed, together with their wages bill. Organized industries in India which come under the Factories Act have been able to absorb so far only 1½ million persons, whereas the handloom industry alone provides employment to 10 million workers. In the absence of reliable data, if we assume that the average earning of a mill worker is Rs. 2 per day and that of a handloom worker is Re. 1 per day, the ratio in which the mills and the handloom are affecting national income are 3 : 10. The facts speak for themselves and need no comment.

The analysis of the foregoing paragraphs indicates that a choice between cottage and largescale factory industries for our national economy is not so easy as many are apt to believe. If a wrong choice is made, it is bound to do irreparable damage to our best interests. The imperative need of the hour, therefore, is the establishment of a permanent Board of Research as recommended by the Manufacturing Sub-Committee of the National Planning Committee charged with the responsibility of studying of the changing economics of largescale and cottage industries production, including the reaction of the consumers and advising the nation on the suitability of one or the other form of production in each particular sphere.—Reproduced from *Commerce*, 28 February, 1948.

Book Reviews

MANAGEMENT IN RUSSIAN INDUSTRY AND AGRICULTURE

By BEINSTOCK, SCHWARZ and YUGOW (Institute of World Affairs, Oxford University Press).

THIS book is the result of a joint study by competent Economists carried under the auspices of the Research Project on Social and Economic Controls in Germany and Russia, sponsored by the Graduates Faculty of Political and Social Science of the New School for Social Research, supported by the Rockefeller Foundation. The study covers a period up to 22 June 1941, the date of the German invasion.

The book is a factual study. The reader is left free to formulate his own opinion. The documents consulted seem to have been selected without bias.

Soviet industry is managed from top to bottom by salaried officials. Talent is well-rewarded. Officials can be made or marred by higher authorities. It is impressive to record that by degrees, absolute authority is now vested in the Plant's Manager. His authority is unique. The 'triangle' or the distribution of power between the Manager, the Plant Committee and the Party has been so diluted that command now rests with the Manager. The 'operational' orders of the Manager are 'unconditionally' binding upon those within the Plant and the auxiliaries. Trade Union share seems to have been reduced to 'increase of labour productivity, strengthening labour discipline, lowering production costs, improvement of production quality, mobilization of industry's inner resources' and the like. It will do well for our Labour Leaders and others communistically inclined to ponder over this, and follow the Soviet example in this regard.

The general working policy of the Plant is laid down by the Supreme Economic Council. The Plant's capacity, equipment, raw material range and rate of produce are fixed by outside authority. The Manager has little flexibility to alter the size of the Plant. Both price and output are fixed by the overall Planning Authority. The Manager is thus left either to reduce quality or bring down cost of production. Both 'planned costs' and 'planned profits' are fixed. The Managers who desire to survive and seek promotion, bonuses and honours try every nerve to bring down costs below the planned figure. He thus raises the level of 'planned profit'. The beneficiaries of this enhanced profit are the State, the capital reserves of the Plant, and the funds are designed for the welfare and efficiency of the personnel. The consumers gain nothing, since prices are fixed. They will be well-off, if deterioration in quality is detected.

As for the structure of economic organization, it would appear that since 1932, the Supreme Economic Council has been split into three large industrial Narkomats or People's Commissariats, namely, one for Heavy Industry, one for Light Industry and one for the Lumber Industry. The Food Industry had been placed under a Special People's Commissariat for Supply since 1930. As problems developed, new Commissariats have been created, until by 1943 there were twenty-five industrial People's Commissariats in existence. The Economsoviet Economic Council, created in 1937, heads up and coordinates all these various Commissariats.

In its turn each Industrial People's Commissariat is divided into Glavks for sub-industries or for areas. The Glavks in turn are divided into Trusts. But as mentioned above, each Plant is conducted upon the principle of one-man control.

The highest planning authority in the U.S.S.R. is the State Planning Commission, the Gosplan, created in 1921. It functions according to Statutes amended by the 1938 Act. It has 54 Departments and has about 1,000 high-grade planning officials. Regional and Plant planning is directed by the Gosplan.

Managers and others in authority are usually men from the party. Efficient men are given every encouragement. Bonuses, specially in kind, act as powerful incentives, specially if they take the form of appointments, transportation facilities and the like. Indeed the regular money salary is often less important. It must also be stressed that the concept of

Soviet prestige and consciousness of serving the country play not an insignificant part in people's motive for work.

As regards agriculture, the Kolkhoz is the universal type of productive organization. The imperative necessity to feed the cities impelled the Government to modernize agriculture. Indeed the petty farmsteads, poor both in technical equipment and capital, were barely able to provide minimum subsistence for the peasants and their families. The first Collective Farms appeared in 1918, combining various kinds of pooling of property, implements and labour. According to the Agrarian Institute of U.S.S.R. in 1928, 70·9 per cent of membership of the Councils were landless peasants, of whom 74·3 per cent owned no horses.

The decrease in production for market had its chief roots in the size of farm units and the structure of agrarian economy. The Central Statistical Office of the U.S.S.R. gives an approximate idea of the relation of market production to size of enterprise. Before the first world war, the market production of grain of large landed Estates in Russia comprised 47 per cent of the total output, that of large peasant holdings 34 per cent and that of small peasant holdings only 11·2 per cent. The Agrarian Revolution of 1917 abolished the privileges of the nobility and the church and gave legal equality to the peasants. But such legal enactment did not solve the problem of poor harvests and chronic crop-failures, nor could the increasing needs of urban centres be well-met. Therefore the antiquated open-field system had to give way to modern crop-rotation, the wooden plough and flail to the metal plough and threshing machine, and extensive methods to intensive methods of cultivation. In 1929, the Government decided to industrialize the nation and launched the First Five Year Plan. Thus compulsory collectivization started in 1929. The new policy was ruthless and painful in its application. The Kulaks according to Stalin's decree were mercilessly liquidated. In 1929, 3·9 per cent of former individual peasant farms and 4·9 per cent of cultivated land area was collectivized. In 1940 they embraced 96·9 per cent of all farms and 99·9 per cent of all cultivated land area. Thus by the outbreak of the Russo-German war, collectivization of agriculture had been fully accomplished. The commune and the toz (cooperative type) of farms were converted into the artel or collective type of farms.

The Machine-Tractor Stations are the keystone to the entire edifice of Soviet agricultural structure. In 1932, they were made exclusively Government-owned and the Government conducted institutions. In 1930 there were only 158 M-T stations servicing 27·4 per cent of all Kolkhozes; by 1940, there were 6,980 such stations servicing 94·5 per cent of Kolkhozes. The M-T stations levy fees for services rendered. They are the owners of all instruments of production and technical skill and guidance. Kolkhozes-land belongs to the Government and cannot be alienated. Work animals are Kolkhoz property.

In addition to collective work, there is room for private property, to have broad opportunity for development. Each household is granted a plot of land for individual cultivation. These small homesteads are cultivated intensively. Income from their output belongs to their holders. Within a short time, they have become an important part of the national economy, especially in the supply of meat, dairy products, vegetable, honey, eggs and poultry.

It was observed that small Kolkhozes on the one hand were not profitable and that giant ones were not efficiently manageable on the other. Size naturally varies with region and crops cultivated. In the Ukrainian region, producing grain and cattle, the Kolkhozes are the largest, while in Georgia, raising mostly grapes, tea and medicinal herbs are the smallest.

The study covers wide ground, but enough is shown to indicate that it is worth the attention of our Statesmen, Planners, Industrialists and Students. (S.K.R.)

News and Views

CHUKAI FIBRE AS A JUTE SUBSTITUTE

IT has been recently reported in the Press that Shri Kshitish Chandra Das Gupta of the Khadi Pratisthan has discovered a substitute for jute which is an elegant shrub sometimes growing as high as 8 ft., and is known as *Chukai* in Bengal. From the following notes it will be observed that *Chukai* or *Chukar* has been known to the scientists and agriculturists from a very long time, and therefore, cannot be regarded as a recent discovery.

Chukai or *Hibiscus sabdariffa* as it is scientifically called, is known to the scientists as a fibre plant since very early times. It has been reported as early as in 1855 by Royle in his *Fibrous Plants of India* as producing fibres of fine silky nature. It has been later reported as a fibre plant in the *Records of the Botanical Survey of India* (1884), in the *Dictionary of Economic Products of India—Watts* (1887), *Useful Fibre Plants of the World—Dodge* (1897), *Commercial Products of India* (1908). Besides, there are many other early references.

The plant is grown throughout the hotter parts of India and Ceylon. It is of a branchy nature and its fibre yield is low, about 10 to 12 md. per acre. The fibre is no doubt strong and silky but meshy and coarse and is, therefore, regarded as inferior to jute. This fibre is commercially known as 'Roselle'.

A variety of this species, *Hibiscus sabdariffa* var. *altissima*, a native of Gold Coast of West Africa has been found to be a heavier yielder. It has a fairly thick and nearly unbranched erect stem. The yield is heavy and may be 25 to 30 maunds per acre. This was first introduced in India in 1927 at the Imperial Agricultural Research Institute, Pusa, Bihar. There are already four improved types of this fibre plant. Some amount of work has been carried out by the Bengal Agricultural Department. The development of fibre and some other fundamental work on this plant have been carried out by Dr B. C. Kundu, Director of the Jute Agricultural Research Institute, Indian Central Jute Committee.

The fibre of *Hibiscus sabdariffa* var. *altissima* has been tested both in India and England. The strength of the fibre is regarded as comparable with that of jute, but the fibre is harsher and rather coarser than the latter. On account of this it was not much considered by the mills at a time when plenty of jute was available.

In a comparative study of the moisture-absorbing propensity and storing quality of Roselle and jute bags conducted by the Bengal Agricultural Department in 1940, Roselle bags, however, appeared to be better in keeping quality as far as sugar was concerned.

The plant can be successfully grown in areas where jute cannot be grown. At the present time when there has been shortage of jute in the country it is worthwhile trying to grow this crop in such areas.

Roselle can never take the place of jute although it has some good properties. It can be very easily mixed with jute and spun in Jute Mills. One drawback of this plant is that it has a very long growing period and is harvested at a time (November) when cold weather has set in with the result that the retting process is prolonged.

The possibilities of various *Hibiscus* and allied fibres as jute substitutes have been engaging the attention of the Jute Agricultural Research Institute of the Indian Central Jute Committee for some time past.

As a result of the decision of the Indian Central Jute Committee at its last meeting research work on this and other substitute fibres have already been taken up by the Agricultural Research Institute of the Committee. Work is already in progress to evolve a quick-yielding type with nearly as heavy yield as is obtained from the normal plant. (I.C.J.C.)

COVER ILLUSTRATION

Oxen crossing a village pond.

8 OCT 1950